SCIENCE SIFTINGS

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"KNOWLEDGE IS POWER."

Volume I.

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INTRODUCING OURSELVES.

THE vice of egoism for which modern journalism is so justly noted, insists that we shall say a few words about ourselves : why we have come into existence, what we intend to do, and how we intend to do it. As a matter of fact, our readers can glean as much from our columns as we can tell them about our mission ; but in case they prefer to shake us by the hand through the medium of our introductory article, we will relate to them, briefly, what we can of our intentions. We hear the reader exclaim, "The old, old cry," but, nevertheless, we must protest that we have come to fill a long-felt want. We are absolutely the first of our kind, and the popular demand has brought us into being. Prior to the advent of SCIENCE SIFTINGS, no scientific newspaper has ever been published in this country for the popular penny, and, as far as we know, this is the first paper of its class ever issued at weekly intervals. The reason for this is not far to seek. There has been no field until quite recently. But of late the public appetite for science has been sharpened to an amazing degree, and it is this demand that has given us the necessary confidence for our venture. All the scientific food we purvey will be the best of its kind, and our first number, which we now have the pleasure of presenting to the public, is a fair sample of the way in which it will be served. It is not our intention to write hard, dry, recondite articles, only fitted for the savant and the scientist, but to dress what we write in the simple garb in which all great truths should be conveyed. In point of fact, we shall cater for the tyro as well as the advanced student. It is the ear of the million we hope to secure, and for this purpose we have enlisted the services of all who can assist us in our work. What we have undertaken, we shall strive to accomplish in a manner that we feel sure will meet with popular approval. We shall endeavour to distinguish fact from hypothesis, truth from falsehood, and above all maintain the dignity of science by inviting all, no matter how humble, to contribute to what we know. No single voice is fitted to fulfil such a mission, and we trust, therefore, that all our friends will assist us to fill our columns, using them to give voice to any thoughts they may evolve, or any criticisms they may desire to publish for the welfare of exact thought, pure knowledge, and accurate science. We ourselves shall do everything that lies in our power to assist in the general knowledge of facts, events, or phenomena, and their powers, causes or laws. We now invite our readers to analyse our first offering. We trust that the verdict will be favourable, but whatever it is, we are content to abide by it. *Spectemur agendo.*

SCIENCE NEWS AND NOTES.

"Science perfects genius," wrote Dryden, and that is exactly what we have come to do.

A Snow dissipator.

That great adapter of scientific discoveries, Mr. Edison, having nearly disposed of the Kinetograph, will next turn his attention to the construction of a sunlight reflector that will melt snow as fast as it falls. He has received an order for such an instrument from a large American iron foundry, whose works are sometimes buried six feet in hard frozen snow. The magnitude of the undertaking is great, but Mr. Edison is confident about success. A snow dissipator would be heartily welcomed in this country, and tend to render the streets of London walkable in a winter like our last.

Smoke.

Then, who knows but what such an invention might not be the forerunner of an electric fog diffuser and annihilator, or a smoke consumer? For it is a mistake to imagine there will be no more smoke when lighting, cooking, and heating are entirely effected by electricity. There is, indeed, a future before electricity, if it can only render the atmosphere pure, and make life livable.

Mr. Edison.

Objection may be taken to our reference to Mr. Edison as "an adapter of scientific discoveries." It must, however, be manifest to all that Mr. Edison does not care for the labour of research, he is quite content to let others do the laborious part of the work, and then step in and adapt their discoveries to his own ingenious ideas. That he has done wonders in this direction we do not wish to deny, but his friends should really abandon their fulsome praises which would have him rank as a scientist. We repeat, he is nothing of the sort, he only rides the horses that others breed and train.

Discoverers and Adapters.

It must not be understood from our observations on Mr. Edison that no credit attaches to the adapter of principles. But the discoverer and adapter cannot stand on the same pedestal of fame, although the latter usually derives the profit, even if the former obtains the praise, which is not always the case. Someone has truthfully said that all knowledge is comprised in two classes. The first is that effect of mind which is the result of curiosity, that species of human instinct that prompts us to inquire the reason for everything we see, every action which takes place among others, among all living beings, among the elements, and among the celestial bodies. Mankind being endowed with reason, the next impulse is to apply the knowledge so gained to some useful purpose, to produce some benefit to ourselves. The first of these two classes is called "scientific investigation," the second is called "applied science."

What is Applied Science?

For instance, we notice for the first time a light from which smoke arises, we investigate, we perceive heat, and that it produces a disagreeable sensation. These are the first scientific facts. We apply the knowledge so gained by resolving never to touch fire. This is applied science. We have employed curiosity to find out the facts. We now employ caution to guard ourselves against damage, and we determine never to touch fire. All knowledge so gained is by this process. We may be told a thousand times that fire will burn, but we feel that that is only theory. We want facts, and we obtain them by a course of scientific investigation. We use these facts and thus gain experience, knowledge, at first scientific, next practical; and these two conditions make up the sum of all knowledge. Science is the foundation, practice the superstructure. Science is a most exacting mistress, although its application is to many—Mr. Edison among the number—only an agreeable pastime.

We see sounds and hear pictures.

For all that, this is a wonderful age we live in. We can now see pictures of sounds and hear colours! The sounds of colours may be easily produced. A beam of sunlight is made to pass through a prism, so as to produce the solar spectrum or rainbow. A disc, having slits or openings in it, is made to revolve, and the coloured light of the spectrum is made to break through it and fall on silk, wool, or other material contained in a glass vessel. As the coloured light falls upon it, sounds will be given by the different parts of the spectrum, and there will be silence in other parts. If the vessel contains red worsted and the green light flashes upon it, loud sounds will be given. Only feeble sounds will be heard when the red and blue parts of the spectrum fall upon the vessel.

A Flying Ship.

Mr. Maxim, the well-known inventor of the gun that bears his name, is now busy constructing a flying ship. He is building his machine of very strong but extremely thin steel plates. It will possess wings, and the motive power will be steam, generated by some patent petroleum combustible. The wings are to be of gigantic dimensions, and the ship, when finished, will measure about eighty feet by thirty feet. Experts who have seen this aerial ship in its present form pronounce success a certainty, as the lines on which it is laid down are so perfectly scientific. There are more wonders than we ever dreamed of in our philosophy, but we take leave to doubt the future of Mr. Maxim's invention. It may be mentioned that the ship is being built in the very heart of London, so we shall all catch a glimpse of her first flight.

Rain Making.

The recent determination of the Government of the United States to usurp the functions of Providence, and control the weather—the rain in particular—has given a big spurt to the dynamite and balloon industries, but we doubt if it has achieved much beyond this. Under certain atmospheric conditions rain may be produced anywhere by concussion, if the explosions are made at a sufficient altitude. Therefore, there is nothing wonderful in certain so-called scientists having watered a few limited tracts of land in Texas, particularly as they have always laid themselves out to catch the most favourable conditions, although in the majority of instances their efforts have not proved successful. They take great credit to themselves, however, for demonstrating a theory as old as the hills.

Rain after Battles.

THE concussion theory orignated in the phenomenon that after a battle there is often a copious shower. But the following quotation from Plutarch's lives shows us that this phenomenon existed before the discovery of explosives :—

"It is observed, indeed, that extraordinary rains generally follow after great battles; whether it be that some deity chooses to wash and purify the earth with water from above, or whether the blood and corruption, by the moist and heavy vapours they emit, thicken the air, which is liable to be altered by the smallest cause."

An elevated temperature or unusual muscular exertion, it is well known, will largely augment the amount of perspiration discharged.

What becomes of Perspiration?

LABOURERS in gas works have been known to lose by cutaneous and pulmonary exhalation nearly sixteen hundred grammes through perspiration in an hour: This is borne out by Professor Huxley, who writes :—

"The sweat glands are largely under the influence of the nervous system, as is proved by experiment upon the horse (cutting the sympathetic nerve in the neck) and by the well-known effects of mental emotion in sometimes suppressing the perspiration and sometimes causing it to flow forth in immense abundance; the amount of matter which may be lost by perspiration under certain circumstances is very remarkable; heat and severe labour combined may reduce the weight of a man two or three pounds in an hour by means of the cutaneous perspiration alone; the quantity of water alone given off from the lungs in twenty-four hours may be taken on an average as about nine ounces, but may increase to double or treble that quantity."

These logical conclusions, derived from actual experiment, show us that battles—which are invariably fought in summer, when excretion by the skin naturally increases—cause the atmosphere to be unduly charged with moisture, and that the gunpowder theory has nothing to do with the subsequent fall of rain.

How much a man Perspires.

IF more argument were wanted to conclusively prove the perspiration theory of abnormal rainfalls, a fairly reliable substantiation will be found as follows :—According to Professor Huxley, one soldier may be expected to give off in battle half a gallon of water by the skin and lungs. Of course he drinks a great deal; thirst for gore, glory, and water, not to mention gin, go together on these occasions. Now, twelve hours is a fair estimate for the average time of conflict in battle. This gives six gallons of water per man during twelve hours, which, by further calculation, we find will cover twelve square feet three-quarters of an inch deep. This is as plain as day, and if the United States Government hopes to succeed in its meteorological efforts, it had better turn its attention to the sweat of the brow and discard villainous saltpetre and its congeners.

Strength of a Spider's Web.

THERE is apparently an enormous industry awaiting only the advent of some inventive genius to revolutionise a gigantic trade, and make a few colossal fortunes. It has been proved by experiment that a spider's thread possesses greater tensile strength, in the proportion of 3 to 2, than steel wire of equal diameter. Why should this thread not be treated in the same fashion as the product of the silkworm? True, its form presents greater difficulties of treatment, but this is where the chance for mechanical skill comes in. Silk is already much used in the making of philosophical instruments, and we believe that as progress in physical science introduces new refinements of the arts of measurement, such delicate products of Nature will find much more frequent applications.

Butter by Electricity.

SCIENTISTS have a way of turning everything to useful account. The culinary department is now engaging their attention, and the terror of the larder is to be converted into a friendly medium. An electrician, who claims that milk sours during a thunderstorm, is considering the possibility of producing butter by the direct action of an electric current on milk. This ingenious gentleman does not appear to have matured anything as yet beyond the idea, although he affirms that it will be the marvel of the twentieth century.

Electrical Drinks.

THE aerating of waters by passing an electric current through them is also engaging the attention of electricians. And the ageing of liquors by means of electricity is likewise a subject of present-day experiment, and a matter for inquiry under the Food Adulteration Act. Altogether, the probable future of electricity in its relation to food is not an engaging theme.

Cooking by Electricity.

ELECTRICITY may, however, prove of immense service in cooking. It has already been applied to this purpose, and the experiment proved fairly successful. There is a good opening for inventive genius if devoted to perfecting a cheap electric heater.

Is Milk soured by Thunderstorms?

OUR elecrician may, however, have many disappointments to contend with before he achieves his end. To begin with, he has based his theories that electricity will convert the milk into butter on the old belief that the lacteal fluid is curdled and soured by thunderstorms. It is, however, not certainly known to what element in the air this souring action on milk is to be directly attributed. An Italian *savant*, Prof. G. Tolomei, has lately made some experiments with the view of elucidating this question. He found that the passage of an electric current directly through the milk not only did not hasten, but actually delayed acidulation, milk so treated not becoming sour until from the sixth to the ninth day, whereas milk not so electrified became markedly acid on the third day.

Milk and Ozone.

WHEN, however, the surface of a quantity of milk was brought close under the terminals of a Holtz machine, the milk soon became sour, and this effect he attributes to the ozone generated, for when the discharge was silent the milk soured with greater rapidity than when the discharge was explosive, in the former case more ozone being formed than in the latter. The souring of milk is generally attributed to the growth of a bacterium which converts the milk sugar into lactic acid. It is possible, then, that the presence of ozone in the air overlying the milk hastens the growth and multiplication of the bacterium. The first observation—namely the retardation of souring by the passage of a current through the milk—may be a point of practical importance.

Effect of Storms on Animal Life.

Is there any scientific explanation of the undoubted disturbance caused to many of the lower forms of animal life by an approaching storm? The low flight of insects, the restlessness of the frog, the unusual noisiness of the grasshopper, and the restlessness displayed by captive leeches will with many others occur at once to the student of nature. All must, however, agree with the remark of that scientific naturalist, Dr. Phipson, who in his very valuable work on "The Utilisation of Minute Life" says: "But for our part we do not place much reliance on the indications of such like barometers, and would advise our readers to adhere to that invented by Torricelli."

Ether and Energy.

It is computed that the amount of energy contained in a cubic foot of space filled with ether amounts to 10,700 foot tons, that is to say, the energy required to raise a weight of a ton to a height of 10,700, or conversely, that required to lift 10,700 tons to the height of one foot. According to this, the energy stored in $2\frac{1}{2}$ cubic feet of ether, is equivalent to that of a railway train weighing 300 tons, and running at a speed of 60 miles an hour.

Atmosphere and Life.

This is assuming that the particles of the ether move with the velocity of light, and that the density of the ether equals one five-millionth of the density of the atmosphere. Given these conditions, which are consistent with what we already know of ether, that medium must exert a pressure on matter immersed in it of 500 tons per square inch. This fine adjustment of pressure conceals the etheric energy from the evidence of our senses; but when the balance of pressure is slightly upset, we are able to observe the perturbation, as in the lightning-flash and thunderstroke, or in the ignition of an explosive. We also owe our own existence to the perfect balance of the atmosphere, and if it were not for this etheric equality, we should soon be literally crushed to a pulp.

The Mysterious Medium.

Speculative science is, absorbed to-day in the study of ether. We seem to be on the verge of discovering something really great about this mysterious medium supposed to pervade all space. The day may even come when ether will form the basis of all electrical text books. The early experiments of Faraday, the marvellous mathematical researches of Maxwell, and the crowning experiments of Hertz, all show the intimate relations which exist between electricity and light. They have so entirely changed our views of science that it has been truly said that electricity has annexed the whole domain of optics.

Twisted Light.

An experiment that originated with Faraday shows that an electric current, circulating through a coil of wire, can actually bend or twist a ray of polarised light. Dr. Kerr in 1875 produced an experiment which showed that when glass is subjected to an intense electric strain, it acquires new properties, and produces a twisting effect upon a ray of light, which is not present when the strain is removed. The same investigator also showed that when an ordinary ray of light was reflected from the highly polished pole of a powerful magnet, it was found to have been twisted or bent in a peculiar manner, and a present-day scientist has produced the converse of this experiment, and magnetised a cambric needle by placing it, for ten minutes, in the focus of a beam of circularly polarised light which passed it longitudinally.

Electric Waves.

Electrical waves have been generated and found by experiment to obey much the same laws as those of light. All of the familiar experiments of reflection, refraction and interference have been performed with electric waves passed through suitable lenses. The far-reaching effect of all these discoveries may not be enjoyed in our time, but that mankind will some day derive the benefit of them is certain.

An Electric Telescope.

It is, says a scientist, in the field of the optical instrument maker that one of the most glorious possibilities of electricity is to be found. What is a telescope? Nothing but a combination of lenses or mirrors, the primary function of which is to bend or reflect a ray of light. But has it not been shown that an electric field will bend a ray of light, and that a ray of light reflected from the polished pole of a magnet is peculiarly twisted? Electricity has hitherto played but a limited part in astronomical science. Its services have been confined to a few technical applications principally associated with signalling and the making of chronographic records, but it is the destiny of this infant giant to work greater changes in the study of the heavens than have ever been dreamed of, even in the scientist's philosophy.

Telephones without Wires.

Harking back to the marvels of ether, we may refer to the photophone, discovered, we believe, by Professor Bell, which shows that it is possible to speak along a beam of light between two distant points that are not connected by wire. True, it is only for a couple of hundred feet, but if for a couple of hundred feet, why not for a mile? And if for a mile, why not for infinity? There is no doubt, however, that it has been clearly demonstrated that a ray of light and, therefore, the ether can transmit speech.

The Photophone.

It must not be understood that the photophone has ever been placed to any practical use. At present it only comes under the very large category of scientific toys. Speculations as to its future are, however, of extreme interest. How will it affect the telephone?

Speaking through a Wall.

Such a possibility as conveying sound to a great distance without wires is of absorbing interest. To be able to speak infinitely into space, except so far as distance is theoretically limited by the curvation of the earth's surface, may, however, be accomplished some day. Of course fogs and mists would cut off the waves of light, but it has been shown that slower waves may be generated which are capable of electrical action, and which can be propagated through the densest fog, and even through a stone wall, with just as much ease as through the clearest atmosphere.

Who Invented the Telephone ?

SCIENTIFIC discovery has never, we are told, made such strides as during the present century, and we are given to plume ourselves on the special development and applications of electricity. We pride ourselves, for instance, on the invention of the telephone, but really we can claim no more than the perfecting of it, and it is to be hoped that we have not yet reached the limit in this direction. The idea of the telephone is at least a century and a half old. Wheatstone describes his "telephone" in 1721, and in 1754, Charles Bourseul wrote : "It is certain that in a more or less distant future, speech will be transmitted by electricity." The disallowance to the claim of the invention of the telephone also applies to many other so-called electrical discoveries—the phonograph, for instance.

Telegraphing by Light.

A SYSTEM of optical telegraphy owes its origin to M. La Cour, a French optician. Instead of availing himself of interrupted rays of light, the inventor sends a signal which can be read at the receiving station like an ordinary letter. The transmission is effected by means of a luminous beam, refracted through prisms, and deprived at its departure of certain coloured rays. The spectrum obtained on the arrival of the signal is interrupted by one or more black bands that correspond to the rays absorbed at its departure. The luminous beam may be made to assume the form of the letters of the Morse alphabet, and a special contrivance serves to modify the light emitted after each signal. The transmission of the signals is accomplished with considerable rapidity. Four or five signals can be despatched simultaneously from the same lamp, which will allow signalling to be carried on at night in a corresponding manner to that of the flag-signalling by day.

A Scientific Flight of Fancy.

THE possibilities attending the substitution of an electric or magnetic field for the glass lens of optical instruments is a subject of some interest. The essential feature of a microscope, for instance, is the objective. The grinding and polishing of such a small lens as is required in a high power microscope is the only limiting factor in microscopy. It is conceivable that an electric field could be formed which would be as small as a mathematical point. A visionary —not a scientific one, it is true—tells us what we might see with such a microscope. But the tale is too lengthy for insertion here. His suppositious lens was constructed out of a large diamond, and treated with an electric current. There are no limits to scientific imagination when bent on such a flight of fancy.

About Telescopes.

IN the case of the telescope great strides have been made since the time of Galileo, and each step has given us a larger object glass, for it is to the size of the object glass that the defining power of the telescope is due. The pupil of the eye is one-fifth of an inch in diameter, and can grasp but a limited amount of light. A 25-inch object glass will enable the eye to take in over 15,000 times more light, and with such a glass the moon can be seen as though it were only eighty miles away, but if the size of the object glass could be further increased the moon would be brought considerably nearer. To make a large object glass is the difficulty, and it is only after years of patient work of the most skilled men on earth and after repeated attempts that one can be produced which is accurate. Slight differences of specific gravity, changes of structure due to jarring, strains resulting from unequal pressure, and changes of temperature are all capable of ruining the work.

Seeing by Electricity.

THEORETICALLY the difficulty could be overcome, and we only await the advent of a scientist who will teach us how to replace the glass lens of the telescope, which is only a medium transmitting light at a different velocity from air, by a properly constructed electric field. It is conceivable that an electric field 50 feet in diameter could be arranged. Just what the nature of this field should be, with our present knowledge, we cannot say : but some day it will be known, and then the secrets of the other planets will be ours.

Electricity from Coal.

A GREAT deal yet remains to be done by producers of artificial light—more by way of economy of energy than in the direction of efficiency. It has even been said that a boy turning a handle could, with his energy properly directed, produce as much light as is now produced by the consumption in massive mechanism of large quantities of fuel. But—there always is a but !—the question is :—"How is the boy's energy to be directed ?" Mr. Edison, by the way, is devoting his attention to extracting the electric energy by a direct method from coal.

The Firefly.

CERTAIN recent investigations show that the whole of the radiant energy of the firefly lies within the visible spectrum. No radiant heat below the red end of the spectrum could be detected by the bolometer—an instrument which has proved sufficiently delicate to measure the thermal radiation from the moon. It was concluded that insect light is associated with about one four-hundredth part of the heat which is ordinarily associated with the radiation of flames. Nature thus produces light at about one four-hundredth part of the cost of the energy which is produced in the candle flame, and at but an insignificant fraction of the cost of the electric light. These investigations are of the greatest interest as showing that the attainment of an enormously high efficiency in the production of artificial light is contrary to no law of Nature, and may suggest a system of electric lighting destined to supersede the fearfully wasteful methods at present in use.

Photography and Disease.

THE latest application of photography to medical science is to use it as a means of locating tumours on the brain. The theory is that spasms are caused by affections of the nervous centres, and that the disturbance of a centre is invariably followed by identically similar contortions of the muscles. A tumour must, of necessity, press upon a nerve centre, producing violent spasmodic attacks. While in this condition the patient is photographed, and the exact position of the tumour discovered. Experiments have been successfully made in San Francisco by an "eminent local surgeon." We must confess we do not follow the reasoning which attributes spasmodic attacks to tumours on the brain. Why not to a tumour on any other part of the body ? There seems to be something wanting in the explanation of the theory.

GLEANINGS OF THE GLOBE.

To make one pound of honey the bees must visit from 90,000 to 2,000,000 flowers.

It takes about three seconds for a message to go from one end of the Atlantic cable to the other.

Henry Ward Beecher used to tell a story about a priest in the olden time who was called to bless the field of a poor farmer prior to the planting. He came, and, after surveying the soil, remarked to the agriculturist: "Praying won't do here; what you want is manure."

A thousand years hence nearly all the stone-buildings now standing in Europe will have crumbled to dust. So perishable is the material of which they are constructed that the process of decay is already evident in many conspicuous edifices. Neither marble nor brown-stone can withstand the action of the elements.

Strictly speaking, the only precious stones are the diamond, ruby, sapphire, and emerald, although the term is often extended to the opal, notwithstanding its lack of hardness, and to the pearl, which is not a mineral but strictly an animal product. Popularly, a gem is a precious or semi-precious stone, when cut or polished for ornamental purposes.

An engine driver on a Scotch railway has noticed that hawks of the merlin or "stone falcon" species fly close behind the train, near the ground, partly hidden by the smoke. As the cars thunder along through the fields and meadows, small birds fly up in clouds, and while they are bewildered and frightened the merlin dashes among them out of the smoke and easily secures its prey.

Mr. H. Darwin, of the Cambridge Scientific Instrument Company, has devised a "cup-micrometer" for measuring the rate of growth of a plant. A thread is attached to the upper end of the plant, and passes over a pulley. To its lower end is fastened a weight, which descends as the plant increases in height. The amount of its descent is a measure of the vertical growth of the plant.

In France, when a patient is under chloroform, on the slightest symptom appearing of failure of the heart, they turn him nearly upside down—that is, with his head downward and his heels in the air. This, they say, always restores him; and such is their faith in the efficacy of this method that the operating-tables in the Paris hospitals are made so that in an instant they can be elevated with one end in the air, so as to bring the patient into a position resembling that of standing on his head.

When the earth was young, says Dr. Ball, Astronomer Royal for Ireland, it went around so fast that the day was only three hours long. The earth was liquid then, and it spun around and around at that fearful speed, and as the sun causes ever-increasing tides upon its surface, it at last burst in two. The smaller part became the moon, which has been going round the earth ever since at an increasing distance. The influences of the moon now rise tides on the earth, and while there was any liquid to operate on in the moon the earth returned the compliment.

The amount of gold in the world would fit in a room twenty-four feet each way.

In average condition, a turnip seed may increase its own weight fifteen times in a minute.

There are spiders no bigger than a grain of sand, which spin threads so fine that it takes 4,000 of them to equal in magnitude a single hair.

The kali mujah, or death-plant, of Java, has flowers which continually give off a perfume so powerful as to overcome if inhaled for any length of time, a full-grown man, and which kills all forms of insect life that come under its influence.

An enthusiast on the subject states that each head of clover is composed of about sixty distinct flower tubes, and each of these contains sugar not to exceed the 500th part of a grain. The proboscis of the honey bee must therefore be inserted into 500 clover tubes before one grain of sugar can be obtained. There are 7,000 grains in a pound, and as honey contains three-fourths of its weight of dry sugar, each pound of clover honey would represent the insertion of its proboscis into 2,500,000 clover heads.

Where it is necessary for a man to be a certain height in order to secure a position, he should be measured in the morning after a good night's rest; or if the examination is to take place in the afternoon, he should remain in bed until near the appointed time. Does a man shrink during the day? Well, that's what he does, and a good inch, too, at that. Just try it some night when you get home from work. Stand against the wall in your socks and get the correct height. In the morning, after a good sleep, put your back to the wall again and see how you have grown.

There is a common superstition that the Red Sea took its name from the destruction of Pharoah and his army, but recent investigations have shown that the name was bestowed on this body of water even before the time of the Exodus. The name is singularly appropriate, and probably arose from the fact that at certain seasons of the year vast quantities of reddish animalculæ float in the water and make the entire surface of a pinkish hue. The animalculæ are said to be peculiar to that sea, being found nowhere else. The local traditions declare the blood of Pharoah and his host appears in the water at the time of the year when the drowning took place. Attempts have been made, but without success, to propagate the animalculæ elsewhere.

The inventor of the game of chess, on being promised by the King, whom he first taught the game, that he should have any reward he might ask for, meekly replied that he would be content if the King would give him one kernel of wheat on the first square, two on the second, four on the third, eight on the fourth, and so on, doubling up to the sixty-fourth square. The King gladly acceded to this seemingly modest request, and ordered his attendants to bring in the wheat, which they began to do; but, to the astonishment of the monarch, it was found that there was not wheat in the whole dominion to pay off the crafty inventor. It would require 9,627,268,786,934,775,168 kernels, equivalent to 30,027,097,184,485 bushels.

PERPETUAL PRIZE COMPETITION.

Every reader of SCIENCE SIFTINGS may obtain a prize by following out these instructions:

Cut off the Coupon at the foot of this column, and beg your friends' Coupons, and then paste them neatly on sheets of foolscap, each Coupon numbered. Send these to the Publishers of SCIENCE SIFTINGS, 78, Fleet-street, E.C.

The largest number of Coupons during the present quarter will receive an award of

Ten Guineas.

These Coupons must be sent in not later than December 31, and the award will be published within three weeks of that date.

With the issue of January 5 (which will be dated January 9) a fresh competition of an identical nature will be started for Coupons commencing with No. 12. Any Coupon not beginning with this number will be ineligible for the second

Ten Guinea

prize; but, as these competitions will continue to the end of our first year, we have determined to award consolation prizes amounting to

One Hundred Guineas,

divided among 100 Competitors who shall send in not less than 500 Coupons DURING THE YEAR. If, however, the number of successful competitors exceeds 100, the Prize will be divided accordingly, and as a further incentive to those who fail in the quarterly competitions, the highest number of Coupons sent in during the year will receive

Five Guineas,

but this prize will not be awarded to anyone who has received the

Ten Guinea

quarterly prize.

Introduce the paper to your friends and obtain their Coupons.

Special Five Guinea Prize.

The above prize will be awarded to the contributor of the best article on "The Condition of Man in 1991." All contributions must be received by December 1, and the award will be made known as soon as feasible. The article must not exceed 2,000 words, and competitors must only write on one side of the paper. Brevity, diction, and general literary excellence will all be taken into consideration in dealing with this competition; and the Editor reserves the right of publishing any article, whether it wins the prize or not.

Coupon No. 1

SCIENCE SIFTINGS

Prize Competition.

Initials of Competitor .....

DOES THE BODY PERISH?

THE theory in reference to the re-grouping of atoms is not entirely new, and in at least one of its aspects it was advanced more than a hundred years ago by the great German philosopher Leibnitz, at a time when the sciences of chemistry and physics were not sufficiently advanced to warrant such a speculation. In the light of modern dynamics, however, it deserves our closest attention, for if it can be shown that matter is composed of ultimate particles, call them atoms, centres of force, or what we like, which are indestructible and in a state of continual vibration, it is difficult to see how we can escape the conclusions, which are forced upon us by this hypothesis.

According to the nebular hypothesis our earth, like all the rest of the planets, once existed in the shape of a gas-ring, which was thrown off or became detached from the sun during its process of condensation. This ring could not retain its form: it necessarily went to pieces, and these afterwards collected into a single gas-globe, or spherical mass, which kept on pursuing its course around the great central body. The gaseous globe radiated an enormous amount of heat, it grew denser and denser, while its diameter diminished; it underwent an endless series of metamorphoses, until it finally became the earth as we know it, the planet which has given us birth. So far, all this is nothing new.

Now, even if the nebular hypothesis should prove erroneous, the conclusions that follow will remain in force, for the same ultimate conclusions can be drawn from every other world-hypothesis which has, as yet, been advanced.

Every particle of our earth, every object, every substance which we now have upon or in our earth, must have already existed in that gaseous ring or primitive gas-globe, no matter in what form or condition, it was there. Could we but follow, in a few days or hours, the changes, the transformations, the endless pilgrimages, which the atoms and molecules of the substances had to undergo during those æons before they became united so as to form, for instance, a human body, what marvels would we behold! The particles of hydrogen, carbon, phosphorus, etc., of which our bodies are composed, what a history might they not tell? In how many other bodies of the human species of animals, plants, and inorganic compounds may they not already have existed, separated, united, differently grouped or arranged? What may they not already have gone through and experienced?

If King Solomon, wise king though he was, really pronounced, or was the first to pronounce, the opinion that there is nothing new under the sun, he could not possibly have been aware of the enormous significance which attaches to this idea in the light of modern science. Why should not the dust of Cæsar which is now filling a bung-hole, why should not those atoms and molecules which two thousand years ago were united in the body of Cæsar,—why should they not, after endless transformations, endless changes, endless transitions, become again united in precisely the same manner; in other words, why should not the same Cæsar of whom we read in ancient history, reappear at a given time; in short, why should not every thing now existing be compelled to undergo the same cycle of changes, and reappear, not once, but an infinite number of times? It would be very strange if such were not the case. The following will illustrate this.

Supposing we were to take six dice, such as are used in

the ordinary game. Let us place them in a little box, shake them, and throw them on the table. We will assume that they had fallen so that each cube exhibited the number three on its upper face; of course, a rare chance. Now it can be mathematically shown after how many throws those six numbers are likely to reappear according to the law of chance. It is possible that they may turn up already with the next throw; on the other hand, we may have to cast those dice ten thousand times. Both cases are improbable: the probabitity lies in a certain number. If, instead of six dice, we were to take seven, the critical number is, of course, so much further removed, viz: it would be necessary to throw oftener to get the seven threes, and so the number of casts increases with every additional cube, till we finally obtain enormous figures. But no matter how many dice, the threes must turn up, if we can throw them long enough, and if, in the case of a thousand dice, it were to take a million years, the threes must appear and reappear again and again after proportionate intervals.

Supposing now, that, instead of dice, we were to take a glass filled with sand. There are, let us assume, twenty thousand sand grains in the glass. Each particular grain occupies a certain position, which is bound to differ from that of all the rest of the sand grains; this the reader will doubtless admit. We shake the glass; the positions are altered, the order of arrangement is disturbed. We shake it again; the sand grains are now in a totally different position. We continue shaking the glass, and the time must come when each individual grain again occupies the exact position which it occupied when we originally started. It is a mathematical necessity, which all will admit who know anything of the calculus of permutations. The twenty thousand sand grains may be looked upon as so many dice, which are bound to fall precisely as they once fell if we can throw them sufficiently often.

Now, there are strong grounds for assuming that our bodies are composed of atoms, or groups of atoms, of a limited number of elementary substances, or of one elementary substance, if all matter has been evolved from one primary element. The number of these atoms may be ever so great, it has nothing whatever to do with the inevitable result. We know also that all other bodies are composed of such atoms, or groups of atoms (molecules); not only those of the human species, animals, and plants, but of inorganic substances, rocks, metals, fluids, gases; in short of every thing that exists in, upon, or above the ground in the atmosphere. We know, furthermore, that the atoms of even the hardest and seemingly most enduring substances, such as agate and diamond, are in a state of continual vibration; that nothing can permanently retain its form; that the entire universe always has been, is now, and always will be in a state of metamorphosis or continual change.

The time must arrive when the atoms or molecules which are now united in our bodies, after countless transformations and wanderings through all kinds of bodies, substances, or intermediary stages, will once more unite in in the same manner; in other words, the time will arrive when the life of every other individual will repeat itself. Yes, repeat itself, and not merely once, but an infiite number of times.

And more than this, there is nothing new under the sun. Those molecules were united in this manner before, and before this again, and 100,000,000 times previously, as far as our imagination can carry us back into the abysmal night of the æons of the past. In other words, each of us has been, ages ago, what he is now, has lived and gone through all this before, has felt and experienced what he now feels and experiences, down to the minutest details. The recollection. of course, is lost. Life and mind itself, consciousness, or "soul," is only a product of matter, and if the same substances reunite in the same manner, the same phenomena must inevitably recur.

Let the molecules which now constitute our bodies undergo ever so many metamorphoses, let them even—which, of course, is very improbable—once fill a bung-hole, let them be scattered about in all manner of forms and conditions, in close contact or millions of miles apart; they must come together again, may the thought please or distress us, —this is the iron logic of modern dynamics.

PERPETUAL MOTION.

Some of the most ingenious and persistent men are labouring at the hopeless task of devising perpetual motion appliances. Our educational system is in many respects responsible for so much mental energy being wasted upon fallacies. If natural philosophy and elementary mechanics received the attention in common schools that their importance demands, there would be fewer persons pestering their friends to supply funds for the development of apparatus intended to cheat Nature's laws. Ignorance of the laws of Nature is, no doubt, responsible for the majority of perpetual motion devotees, yet some men who are well educated become pursuers of the chimera. It is frequently difficult to understand the mechanical fallacies that creep over what are otherwise bright intellects. Electricity seems to be deceiving many men and leading them into the belief that by means of this mysterious force more power can be received than what is given. Since the electric lighting and electric transmission of power era began, there has been a great increase in what profess to be electrical perpetual motion machines. A correspondent of an American paper gives particulars of some curious recent perpetual motion cases. Mr. Keely has a good many imitators in a small way. A few months ago a New York lawyer went to Washington with parts of a machine, and had quite a controversy with the office because the patent was refused. He insisted that he had seen the machine in operation, that it was running day after day, and keeping a cider press going to boot. There was no deviating from the rule. The lawyer went back to New York, saying that he would produce the machine. He was not seen again until lately, when he reminded the examiner of the case and told him how he had been fooled. At the time of making application the lawyer really believed that his client had discovered the long-sought principle. But when he got back to New York and told that the patent had been refused, the client confessed. The perpetual motion was no motion at all. Power was concealed in the cider press. It ran the press, and the press made the perpetual machine go too. The inventor had been charging 10 cents admission to see perpetual motion. He had fooled the public and his lawyer, and he hoped to slip through a claim.

LITERATURE.

Publishers sending books for review will oblige by stating price.

Books Received.

Other Suns than Ours, by Richard A. Proctor, Second Edition. (London: W. H. Allen & Co.)

Geodesy, by J. Howard Gore. (London: W. Heinemann.)

Magic Lanterns, How Made and How used, by A. A. Wood, F.C.S. (E. G. Wood, 74, Cheapside, E.C.)

PHRENOLOGY EXPLAINED.

By Stackpool E. O'Dell.

Author of "Phrenology: its Truthfulness and Usefulness," "Old St. Margaret's," "Merciful or Merciless?" "Brompton Lectures," "Mental Troubles," etc.

I.

In introducing the subject of Phrenology, a few references to the opinions of great authorities that have shown faith in its revelations will not be out of place. In the *Encyclopædia Britannica* we read: "To Phrenology may be justly conceded the grand merit of having forced the inductive method of enquiring into mental philosophy, and thus laid the permanent foundation of a true mental science." *Chambers' Dictionary* describes Phrenology as "The Science of the Mind. The Science of the Faculties of the Brain and its different parts." James George Davey, M.D., M.R.C.P., says, in the *Journal of Psychological Medicine*, "The correctness of the localisation of the functions of the brain by Gall and Spurzheim become at once so plainly demonstrated that the non-acceptance of Phrenology is next to impossible." Professor Tyndall says, in his *Manchester Science Lecture*:—"Given the shape of the brain, and the corresponding thought might be inferred." Sir Charles Bell, in his *Anatomy*, gives utterance to the following belief:—"The bones of the head are moulded to the brain, and the peculiar shape of the bones of the head are determined by the original peculiarity in the shape of the brain." Gordon, Majendie and Pinel are of the same opinion, while Mr. Samuel Solly, F.R.S., the Senior Assistant Surgeon at St. Thomas' Hospital, in his book on *The Human Brain*, delivers a like opinion. He writes:—"The skull is modeled in its form and shape by the brain, though it is not uncommon to hear the opponents of Phrenology ridicule the idea of a soft brain producing any impression on the hard skull." He continues:—"Those who have not given their serious attention to Phrenology have a sort of indefinite idea that Phrenology is some occult science by means of which its professors pretend to be able to judge of a man's character by an examination of the bumps on his head. This is the Phrenology of the superficial and the idle, who, not having industry enough to investigate for themselves, set up a baseless shadow, and then take credit for the facility with which they overthrow it. This is not the science of Phrenology, but the phantom of their own imagination. In the first place, the term "bump," in reference to the surface of the skull, has no place in the vocabulary of the educated phrenologist." Archbishop Whatley was of opinion that:—"All moral and religious objections against the doctrines of Phrenology are utterly futile. Its metaphysical side is far more logical, accurate, and convenient than Locke, Stuart, and other writers of the same school." Sir William Ellis, M.D., late Physician to the Middlesex Lunatic Asylum, says:—"Until I became acquainted with Phrenology I had no solid foundation upon which I could base my treatment for the cure of insanity." This testimony is confirmed by Dr. W. A. P. Browne, one of Her Majesty's Commissioners for Lunacy.

We have given the above quotations for the purpose of showing to those who have not the time or the wish to study Phrenology for themselves, that they may accept Phrenology as a science upon the authority of others. We have here eminent names—scientists, churchmen, and statesmen. We might multiply these names, but do not think there is any occasion to do so. The articles which we intend to publish weekly will, we hope, tend towards a better knowledge of that mind which we all possess, of those mental qualities which we all have, though in various degrees of strength and activity. We believe that each article will be of intense interest to each reader, for in it they will perceive some characteristic of their own mind, both in regard to its strength and its weakness. We shall likewise be able to show the benefit to be derived from this knowledge.

We intend to dwell more upon the psychological than the physiological side of Phrenology. The psychological side is understandable and almost uncontradictable.

ELECTRICITY AND LIFE.

It seems to be a pretty well-established fact that electricity may be made at least a powerful stimulant to the growth of plants. May it not be more than a mere stimulant? May it not be an actual creator of life? Beans, rye, corn, oats, barley, peas, potatoes, sunflowers, clover and flax, have all been experimented upon, in some cases with astonishing results. In one series of experiments the seeds were electrified before they were sown; in another, currents were maintained through the soil in which they were planted; and still another, through the atmosphere immediately above the plants. In several instances the yield of fruit was enormously above the average, and in all the growth was unusually luxuriant. Further experiments are in progress, and it is not unlikely that science is about to add another to her long series of beneficent triumphs.

The results of the experiments have, furthermore, a suggestive bearing upon the relation between electricity and that inscrutable something which we call life. If they do not prove them the same, they at least bring them nearer together than any phenomena which have preceded them. When, in the healing art, enfeebled vitality is restored, either wholly or in part, by the skilful application of electricity, nothing is positively demonstrated beyond mere healthful stimulation, the mere awakening of life which already lay dormant in the system, such as might possibly have followed the use of other remedial agents. But here it is not morbid restored to normal conditions, not dormant life reawakened to action. It is apparently the actual development of vitality not pre-existent in the perfectly healthy and normal organisms under treatment. Electricity itself appears to be converted to vitality, as elsewhere it is converted to light, heat and mechanical motion.

Whether life can thus not only be renewed, but actually transfused into the veins, or rather, the nerves of man remains, for physiological science to determine. It has already been shown that a living body is a species of thermo-electric battery of which the ectoderm and the endoderm, that is the outer and inner skin respectively, are the opposite poles; that the exhilarating effects of a cold plunge, for example, are due simply to the increase of potential from the reduced temperature of the "cold" electrode. But merely setting a battery into operation, or merely increasing its action, is not increasing its inherent voltage, which is what the recent experiments seem to have done for plants.

But do not heat and the active principle of light artificially intensified produce similar effects? The forcing of vegetable growth in hot-houses is an old process and unlike the one in question, both in method and effect. According to the reports given, however, there is a very great difference in the results attained. If this be true, it would seem to indicate more strongly than ever that of all forms of natural force, electricity bears the closest relation to that mysterious form of it which we call life.

WHAT IS ELECTRICITY?

THERE are three kinds of electricity. First is the lightning, which Nature produces. Then there is battery or static electricity, which is generated by dissolving chemicals in cells or batteries. The third sort is dynamic, being generated by a dynamo. The currents generated by chemicals are usually moderate in power, although by the combination of a number of cells a very considerable current may be generated. These currents of battery or static electricity are the kind used in telegraphing and telephoning. The most notable characteristic of battery currents is that they are absolutely steady and continuous. They only grow weaker and die out as the chemicals become exhausted.

The dynamic are the powerful currents. They are used for lighting, for power, for transit, and for all of the branches of the new industry. There are three kinds—continuous, fluctuating and alternating.

The dynamo and the generation of the electric current may be described in this way. Upon an iron core a great length of wire is wrapped back and forth, its terminals being carried to a cylinder on the end of the axle, called the commutator. This coil of wire is placed within the field of a powerful magnet: it is belted to steam-power and the coil of wire is revolved rapidly within the field of the magnet. This action generates a volume of electricity. The quantity which may be generated thus depends upon the size of the dynamo employed and the rapidity of revolution. By the interposition of a conductor this current can be taken to great distances and utilised for light and power. By means of devices, known as brushes and copper wires, the current is conducted away from the generator to the points where it is to be used.

That is, in short, the story of the generation and application of electricity for power and light. Some people who read it will wonder why it is printed. Others who went to school before this electrical age began, and who have read darkly of the use of electricity, will read this brief explanation and feel that some of the mystery of the new industrial energy is cleared up for them.

There is arc lighting and incandescent lighting. Arc lighting is explained in the following way:—Being provided with a steam plant to drive the dynamos, and dynamos of sufficient generating capacity wires, are strung from the generator on poles from which they are carefully insulated to the point to be lit. Light is made wherever needed, by a break in the continuity of these wires. Wherever such break is made the broken ends are kept in close proximity, and the current leaps across the breach. This is known as an electric arc. Wherever such an arc occurs it produces intense heat. Availing themselves of this knowledge, electricians place upon the tips of the broken wire, at the point of breach, a substance which, under great heat, possesses the quality of incandescence. Thence the wire proceeds to the next point where a light is needed, and there another break in the wire is made, and the breach provided with incandescent tips, and so on throughout the circuit, until the wire is brought back to the negative pole of the generator. When the dynamo is started, light is secured at each break by the heat of the electric arc producing incandescence in the substance provided for that purpose at the points where light is desired. A powerful current is necessary to produce the arc lights. It is procured by large dynamos furnishing great quantities of electricity, which is driven out under an immense pressure as high as 2,000 to 2,500 volts, each light requiring about 50 volts. This voltage of electricity is deadly. A person receiving a full shock of a current of that voltage would be instantly killed. For that reason great care is taken in the construction of arc-light wires, and they are invariably built not only on pure metallic circuits, but the wires are thoroughly surrounded by insulation to prevent accidental contacts or escape of current. The current employed in arc lighting is what is known as a continuous current; that is to say, it flows always in one direction, with as little variation in intensity as practicable. But it differs from static or battery currents in this, that, whereas they are of a steady intensity or potential, as it is termed, no dynamo has as yet been invented which gives an absolutely steady current. Either from irregularities in the speed with which the generator revolves or in the material used in its construction, or from one or more of many other causes, the most perfect dynamo current is a fluctuating current, varying in intensity from moment to moment. This variation of current creates in the wires over which it passes a humming or a buzzing or a cracking sound, not heard in battery currents.

Induction is another of the common but, to many people, incomprehensible words which have come in with the electrical age. When a wire charged with a heavy current of electricity is strung parallel for a considerable distance to another wire upon which there is no electric current, or a much weaker current, the strongly charged wire excites in the weaker wire a sympathetic current, which moves in the opposite direction, but vibrates, pulsates, crepitates, and in all other respects reproduces the manifestations of the current in the stronger wire. This is induction. The distance at which it will be produced varies with the intensity of the current, the atmosphere, and the size of the wire.

An understanding of what is meant by induction is absolutely necessary to the explanation of certain systems of incandescent lighting. In many systems of incandescent lighting the wires, from the generating plant, are carried to the outside only of the buildings to be lighted. There they are placed in a coil in close proximity to but not in contact with another coil wire leading into the building. From this last-named coil, called the "induction coil," wires are carried to the glass bulbs which we see on every hand, in which are placed carbonised loops. Under the systems resorting to the method, the incandescent lights in the building are produced, not by the introduction into the building of the original current, but by the sympathetic or induced current described above, set up in the induction coil from the passage of the direct current on the wire and coil outside the building.

The dynamo current employed for such systems of incandescent lighting is entirely different from that used in the arc lighting, being what is known as an alternating current. The alternating current is produced by reversing the poles of the magnet as rapidly as possible, thus making the electric current flow back and forth in opposite directions many times a second. This alternating current is of great intensity, is the noisiest of all currents upon the wires, and is fatal to human life at a much lower voltage than a continuous current would be.

WHY WE WASTE.

A PROCLAMATION by an eminent physician that he has discovered a specific cure for consumption in its most prevalent and insidious form, known as tuberculosis, might well create a deep and universal interest, since there are comparatively few of us that have not this deadly enemy within the limits of our cousin kinship. And if German slaughter house statistics are to be taken as representative, no less than ten per cent. of our domesticated horned cattle are a prey to the same disease, though seldom discovered during life. This fact would suggest that tubercular consumption is still more prevalent in the human family than has yet been supposed, and that many carry it under the cover of other maladies.

But unfortunately for any hope for a specific remedy, the preponderance of evidence points to the fact that consumption is much more a product of individual habits and social and climatical conditions than a resultant of any one agency. Indeed, the causative evils may vary not only in their degree, but also in their number and order of action in the period of its evolution.

If it were hereditary in the sense that it is transmitted by the blood as a specific germ or virus, then the offspring of consumptives would have an attenuated form of the disease, which, by reasoning from analogy, ought to secure them exemption from any further danger along that line. Such, however, is not the case. But if we say a special fitness is inherited, then we can understand how the offspring of consumptives are prone to develop it, since they are not only born with hereditary qualifications, but not infrequently they are cradled amid the very agencies which fostered the evil in their parents, if, indeed, they were not primarily causative.

That the contribution of heredity to consumption is great is undoubtedly the case, and, more than any other factor, it would seem to have a directing power in the army of inducing evils. But the fact that the greater number of the offspring of consumptives escape the disease, even where the general family resemblance is quite pronounced, is readily explained by the difference in personal habits, the circumstances of different periods or the domestic regulations instituted by medical counsel. Also the fact that consumptives so frequently spring from neurotic parentage and the victims of dissipation, especially alcoholic, still farther goes to show that the hereditary element is essentially a reduced power of resistance to formative evils, and that as a negative condition it may hold the balance power in focusing the forces. Thus, heredity, in disease, can be understood as in no sense implying a specific force, but rather an atonic or susceptible condition, varying in its precise character and producing a *pars minoris resistentiæ*—a special weakness in a special way.

That the germ *bacillus* does not originate consumption there can be no doubt, unless consumption is not to be regarded as a disease until it is full fledged, for otherwise the germ would be present in the earlier formations, as well as the later, which, according to good authority, is not the case. But that this parasite has a special affinity for consumptive tissue there is no question, and that it thrives therein with great rapidity, hastening retrogressive changes, is also to be granted. But, as yet, this is all we are entitled to believe.

We thus see that the lines of successful treatment must be both constitutional and local; that the constitutional cannot be specific, and the strictly local cannot be curative. The constitutional must be of a negative and positive character, having regard to the support of the healthy remnant, and which will require correction of any deficiency whatsoever in order to remove the morbid constitutional habit. The local will be cleansing of the affected organs from the germs and morbid products.

The evident selective affinity of Koch's lymph for tuberculous tissue may enable it, in certain cases, to effectually seal the arterial capillaries about the affected parts, owing to the intense vaso-motor disturbance produced. This would starve the germs, which, with the tubercular matter, may be expectorated through the moisture and motion of the lungs. In incipient cases the tubercles might be as readily absorbed as catgut ligature, and the germs, if any, fall to phagocytic prey. The Koch lymph is evidently not a poison to the germs, and probably has no other action on the affected organs than that of an irritant, having a selective affinity by virtue of the kinship with its contents. This theory of its action is supported by our common knowledge of the power of pyogenic agents to awaken old or slumbering inflammations, and the fact that septic fevers, such as small-pox, have been known to leave the consumptives with the last stages free from every symptom.

FACTS ABOUT FLIES.

THE popular notion that house flies walk on the ceiling by the help of the suckers on their feet is a mistaken one. Notwithstanding the testimony on this point of many old and respected authors, the fact is that the fly has no suckers on its feet at all, but each of those six members end in a pair of little cushions and a pair of hooks. The cushions are covered with ever so many knobbed hairs, which are kept moist by an exuding fluid. Thus a fly is able to walk on a smooth wall or ceiling or window pane, and apparently defy the law of gravitation by the adherent power of the moist, hairy pads. You will understand the theory of it if you will touch the moistened end of your forefinger to the window glass or any smooth surface and observe the perceptible adhesion. For walking on rough surfaces the fly's foot cushions are of no use, but the insect is provided with the twelve strong hooks mentioned to do its rough travel with, clinging by them to any such surface as a white-washed wall or cloth.

Another prevalent fallacy is that the smaller flies seen in houses are young ones. As is the case with all insects, the fly's growth is accomplished in the larva state; it ends with the issuing from the pupa and expansion of the wings. Individual flies differ in size or maturity, just as is the case with man and other animals. Every house fly that you see was once a crawling maggot. The eggs laid by the female fly are usually deposited in warm manure or in decomposing vegetation. Each stable in summer that is not kept remarkably clean is a hatching and propagating place for flies. Within twenty-four hours after eggs are laid they are hatched out into footless maggots, which inhabit the filth they are born in for a week and then contract to little brown objects known as puparia. Within this hardened skin the maggot is transformed into the perfect fly, which crawls out of the puparium five days later, already grown to full size, and wings its way to share your luncheon. A fly lives about three weeks. When the cold weather comes the flies nearly all die: but a few vigorous females remain torpid in nooks and crannies, thus surviving the winter and continuing their species.

PREMONITIONS, COINCIDENCES, AND SUPERSTITIONS.

Nobody can fully explain the states of his own inner consciousness, or tell the reasons why, when in apparent good health, the atmosphere is luminous with transcendental glory, and anon is shadowed by dimly comprehended spectres. Many individuals have strangely recurrent coincidences or presentiments, which, considered abstractly, are—whether forewarnings of good or of evil—so frequently fulfilled that it is difficult to assume them to be casualties only. Science, however, is dumb in explaining the *rationale* of such phenomena. There are times and seasons when the entire firmament is rose coloured, and then, without any apparent reason, the heavens are overcast, and we each learn this lesson anew, that the cause of our sorrows, discomforts, and misfortunes lies deep in the nature of things. Perhaps this is one reason why we pay attention to mystical forecasts, and there seems to spring into existence "the prophetic soul of the wide world dreaming on things to come."

It is customary to say it is lucky to do a certain act at a certain time; it is unlucky to do certain things, or to leave undone this, that, or the other thing. If logically traced to the source from which such observations sprang, it is found all such superstitions are based on the law of coincidences. Take an individual in a slightly morbid or reflective state, and the dark side of human affairs thrusts itself upon his notice—the tyranny of the strong toward the weak, the cruelty abounding in nature, the transitoriness of all human affairs; and let a number of coincidences occur bearing upon some one of these subjects of thought, and a superstition is founded, which may be transmitted and become perpetuated from generation to generation.

Many persons reject and ridicule the common superstitions found to exist quite as much among the intelligent as in the every-day life of the common people. The individual who sits at the table, making the company thirteen, will laugh and jest at the timorous anxiety of his hostess, who had—previous to his unexpected arrival—been to considerable trouble to avoid such a casualty, but will feel uncanny if he spill the contents of the salt jar accidentally, and will hasten to burn or throw some over his shoulder immediately, to ward off any evil effects which might otherwise occur in his business relations; or he will pass some anxious moments if he observes the new moon over his left shoulder, instead of his right, nor will he undertake anything important on Friday. Many persons who pride themselves on being proof against the folloy of superstition yet feel uneasy if they do not observe the rules governing this bit of unreason in other people. Scientific scholars who have reasoned from effect to cause, who have accepted the fact that matter and force are indestructible—such minds may be observed to be influenced by the good will of Pussy, she having since the days of the Egyptians traditionally brought good luck to the house of her choosing; while the breaking of a mirror is supposed to bring misfortune seven years long to the unlucky possessor.

Most of these superstitions can be read by the law of coincidence. Thirteen persons at table coincides with the unlucky number at the memorable supper in which Judas betrayed the sinless one and went to his own death. Spilling salt is coincident with the evils that accrued to the salt-tax gatherers during the French revolution. The strangest part of these coincidences—which, if observed until sufficient data are collected, may be termed analogies—is that there seems to be a certain unexplained law of the mind in its groping that often leads to new facts and discoveries.

In his *Budget of Paradoxes*, De Morgan relates the following story or theory: "The late Baron Zach received a letter from Pons, a successful finder of comets, complaining that for a certain period he had found no comets, though he had searched diligently. Zach, a man of much sly humour, told him that no spots had been seen on the sun for the same length of time—which was true—and assured him that when the spots came back, the comets would come with them. Some time after, he got a letter from Pons, who informed him with great satisfaction that he was quite right; that very large spots had appeared on the sun, and that he had found a comet soon after."

To make the story complete there should now be found a connection between the comets and the sun's spots. The curious thing is that just this paradox was maintained before the Royal Astronomical Society by Professor Ashe before De Morgan's book came out.

We have known one who has the capacity for invention to make statements about the necessary mechanical appliances needed to produce certain ends, that sounded wildly improbable; and yet the most improbable are now facts. The quadruplex system for use in telegraphy was dreamed of when to relate the dream was a tale of wild improbability. This has occurred many times, and allows a perfectly natural interpretation—as some other mind traversed the same road and solved his dream into practicability by creating the necessary steel and iron image to express an embodiment of his thought.

Again, there have been well attested instances in which mind acts on mind independently of distances. It would be hard to prove that when we think—and that in spite of a determination to think of other things—of some absent person that he is thinking of us. But if in a number of instances a number of persons were to record such experiences and compare results, the law of coincidence would have great weight in determining the truth or fallacy of such a law. In trying to grasp an abstruse subject like the relation between mind and matter, there must, from the nature of the working medium, ever be many opportunities for fallacious reasoning—as it is impossible to speak of mind as affiliated with the body, with a brain and the nerve currents, without localising the mind, and proving its habitat and absolute identity. Mental and bodily states are never indentical, but contrasted. There is no means of effecting a compromise between them, and in trying to express thought about mind it is not easy to say anything without localising it. There is the old difficulty to be met: Is mind found in every organ, or all in the whole?

Leaving all this, however, and allowing the statement that mind is, indeed, as a phenomenon different from physical force, but correlates more or less directly in strict proportion with these, mind must be admitted into the circle of correlated force. Of course, it is quite impossible to reduce the quantity or quality of mind force to any method of mathematical precision. Vitality, energy, mental qualifications, health, courage, love, irascibility, may have a standard in our own mind with regard to an individual, but we cannot reduce such qualities with mathematical precision, and cannot communicate to others with exactness our own idea. When taking into consideration the physical facts underlying the mental facts, it may show that widespread concomitant action of the nerve currents and the agitation of the brain that may account for many of the unexplained incidents, divinations, witchcrafts, and similar phenomena as a result of that tumultuous conflict, and exercise of energy in reconciling the union of the material to the immaterial, even among the inferior races of mankind.

SIGHT TENDENCIES.

Are people in the city weaker in their organs of sight than the people dwelling elsewhere? A leading oculist declares they are. He has had enough opportunities to observe, and, besides, he offers such good reasons for his assertion that one is convinced of the truth of his deductions. Weak eyes, according to this gentleman, are increasing in number as well as in the degree of weakness, and the greater part of these impaired visual organs is due to the fact that the workers of the city labour too hard and the idlers live too fast. Office work, where the toiler is fairly chained to his desk, and his eyes glued to the books or paper, and with bad light in the majority of cases, is sure to have a bad effect upon the sight. Fully 20 per cent. of the office men in the city are afflicted with weak eyes. Add to these unwholesome or defective conditions the liability to overwork, to under-eat, to eat too fast, and to exercise too little, and the eyes are reduced to their weakest state. Then a little over application of constitutional agitation will make them nearly unfit for good service.

There is no prospect, says he, that this state of affairs will stop. On the contrary, he thinks that our business and social habits are all conducive to impaired eyes. When a person feels that his eyes are giving out he should consult an optician or an oculist without delay. Absolute rest in most cases is the only cure, and even then it may not wholly remove the cause of the evil. Glasses, properly fitted, will relieve and give aid in many cases. Diet, eating, and exercise have more to do with the condition of the eyes than the majority of people suppose. If your habits of living are irregular the eyes will soon feel the effects of such irregularity. A great many persons buy glasses and wear them when their eyes are weak more in imagination than in reality. But these are few in number in comparison with the great number who wear glasses because they have to wear them. Sometimes good, nourishing food, properly eaten, and reasonable exercise will remove all complaint and restore the eyes to their normal state. Typewriters are liable to lose their sight because their eyes are so constantly and so closely applied to white paper. There seems to be little hope, however, for the toilers of this big city so long as they persist in burning the candle at both ends by too close application to their work. All of which, while good for the opticians, is not quite so promising for the people.

COUNTING A BILLION.

What is a billion? The reply is very simple—a million times a million. This is quickly written, and quicker still pronounced. But no man is able to count it. You count 160 or 170 a minute; but let us suppose you go as far as 200, then an hour will produce 12,000; a day, 288,000; and a year, or 365 days, 105,120,000. Let us suppose now that Adam, at the beginning of his existence, had begun to count, had continued to do so, and was counting still, he would not even now, according to the believed age of our globe, have counted near enough. For to count a billion he would require 9,512 years, 542 days, five hours and twenty minutes, according to the above rule. Supposing we were to allow a poor counter 12 hours daily for rest, eating, and sleeping, he would need 19,025 years, 319 days, ten hours and 45 minutes.

OVERWORK *v.* OVEREATING.

An abuse that tends to injury of the brain-workers is excessive eating. A medical writer recalls to mind several active brain-workers who suddenly broke down and fancied that it was due to brain fatigue, when, as a matter of fact, it was due to overstuffing on their part. The furnace connected with their mental machinery became clogged up with ashes and carbon in various shapes and forms, and as a result disease came, and before the cases were fully appreciated a demoralised condition of the nervous system was manifested, and they laid the flattering unction to their souls that they had indulged in mental overwork. Hard work, mental or physical, rarely ever kills. If a mild amount of physical exercise be taken, and a judicious amount of food be furnished, the bowels kept open in the proper manner, the surface be protected with proper clothing, and the individual cultivates a philosophical nature and absolutely resolves to permit nothing to annoy or fret him, the chances are that he can do almost an unlimited amount of work for an indefinite length of time, bearing in mind always that when weariness comes he must rest, and not take stimulants and work upon any false capital.

The tired worn-out slave should not be scourged to additional labour. Under such stimulus the slave may do the task, but he soon becomes crippled and unfit for work. The secret of successful work lies in the direction of selecting good nutritious food, taken in proper qualities, not eaten as a "gourmand"; the adoption of regular methods of work, and the rule of resting when pronounced fatigue presents itself, and determining not to permit friction, worry, or fretting to enter into his life.

GOOD AND BAD BACILLI.

The microscope seems to be demonstrating that our bodies are made of little else than bacilli, germs, spores, bacteria, microbes, etc. And as in the old tales there were good and bad fairies who influenced the destinies of mankind, so there are good and bad bacilli. Some of them are necessary to our health. For instance, in the mouth of a healthy person there are always present no less than twenty-four microbes already discovered, with several outlying districts still to hear from. In disease the number of microbes in the body is multiplied innumerably.

Our friends, the microscopists, have not yet reached that point where they tell us the good bacilli are beautiful infinitesimals and pleasing to look upon, while the disease germs are wicked and ugly little monsters, but plainly, that is how it ought to be, if there is any poetry or justice in the microscope world.

The bad bacilli that play havoc with the human insides and produce illness are called pathogenic, while the good bacilli are called non-pathogenic. These are the little fellows that devour the bad monsters, act as scavengers to the system, and make the cheeks rosy and the teeth white. Each disease has its own particular bacillus, and when you have one kind of illness sometimes the bacillus of another ailment will attack and destroy the army of the first one, and thus you are cured of one trouble at least.

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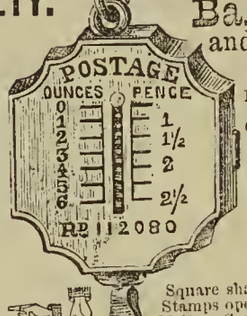

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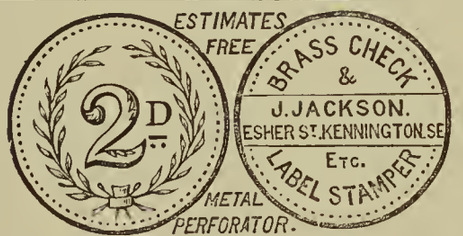

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SCIENCE NEWS AND NOTES.

Our First Appearance

caused quite a sensation in the reading world, for people have not been in the habit of having their science purveyed in such a pleasant form or at such a low figure. That the general public has taken an extreme interest in SCIENCE SIFTINGS, is evidenced by the fact that for many days before we published we received several hundred letters *per diem*, each inclosing stamps for copies of the first issue when it should make its appearance. We congratulate the public and ourselves on the success of our first number.

The Language of Animals

occupied the attention of the writers of fairy tales in the days of yore to no inconsiderable degree, and the recent experiments with the phonograph on the gentry of the Simian tribe would seem to point to a revived interest. We have no opinion on the subject ourselves, because personally we never had the pleasure of conversing with a monkey, but Professor Max Muller is worth listening to. He says :—"If all true science is based on facts, the fact remains that no animal has ever formed what we mean by a language; and we are fully justified, therefore, in holding with Bunsen and Humboldt, as against Darwin and Prof. Romanes, that there is a specific difference between the human animal and all other animals, and that that difference consists in language as the outward manifestation of what the Greeks meant by *logos*."

Rain-making,

if all that our trans-Atlantic friends claim for it be true, may be at some future date the foundation of a very important profession. Since, doubtless, if we succeed in inducing rain, we may, by the inverse operation, effectually stop unwelcome downpours. The latter branch of the profession would be more popular with us than the former. Very ingenious are the many theories advanced with a bearing on this subject. As we said last week, we are disinclined to believe that the noise of an explosion can produce a fall of rain. Everyone has noticed that when water passes from the liquid to the solid condition, the process begins about some foreign substance. Little sticks and straws projecting into the water are first girdled with a fringe of ice. It has been observed by some scientists that the same is true of water in passing from vapour to liquid. This affords another rational explanation why rainfall follows a battle. Think of the volume of smoke and dust sent up in the atmosphere during an all day's engagement between two powerful armies. Each minute particle of carbon or sulphur or dust, too small for detection in the rain, forms a nucleus upon which the molecules of aqueous vapour cluster very like a swarm of bees settle on a limb. The eruption of volcanoes is almost always attended with heavy rainfall, and during an eruption the quantity of ashes and cinders hurled thousands of feet into the heavens is inconceivable. They have been known to fall hundreds of miles from the place of eruption.

Hygienic Dress

is a subject that does not receive half the attention it deserves. We are not reverting to the old vexed question whether breeches or skirts are the most desirable form of apparel for women, but rather to the dissemination of disease through ignorance in dressing. For instance, most men and women wear the same coat or dress day after day, without giving their garments an opportunity for getting rid of the poisonous matter that naturally accumulates in them. Again, the present-day fashion of wearing dresses that draggle in the dirt and dust results in the carriage of an infinity of microbe life into the house, and disease is the natural sequence.

The Human Ear

possesses 3,000 little fibres which form the termination of the auditory nerve. The existence of these fibres was made known by Corti, whose name they bear. Helmholtz tells us that each one of these fibres is tuned to a particular note to which it responds. The principle upon which these fibres act is that which governs the production of sympathetic vibrations. If a cornet sounding the note C be played into a piano, it will be found that the C string of the piano will emit that note, even after the sound of the cornet has ceased. In a similar manner one of these little filaments of the ear responds to a given note and conveys to the brain a special sensation which is always recognised as belonging to that note and which cannot be produced by any other.

Only those Notes,

we deduce from this, which are represented by fibres can be perceived by the ear, a note having a very high or a very small number of vibrations could not produce an audible effect; the limit of audibility would vary with different ears, some having a greater and some a less number of the fibres of Corti, and certain animals might be able to hear sounds which are too high for the human ear. It has been found that all of these things are true, and it is a matter of common observation that dogs and even savages are frequently much disturbed by noises which the civilised human ear cannot notice. It would be quite possible for beings having voices pitched at a very high key, and ears to correspond, to carry on a conversation which we would be totally unable to hear. For aught we know, the air may be at all times filled with most beautiful music. We certainly know that it is constantly agitated by sounds which we cannot hear.

Those Unheard Sounds

and the mysterious music of Nature—which has for centuries wasted its sweetness upon the dull ear of mankind—may never be heard by us, although science answers with the phonograph, and says that by its aid we may annex, perhaps, another world. It is conceivable that by employing a sensitive mirror vibrating a beam of light upon a moving photographic paper we may record vibrations which are too rapid for the unaided ear, and then reproduce them in the phonograph at a lower pitch, thus bringing them within our range. In the same manner vibrations which are too slow to affect our ear as music, might be recorded and then phonographically reproduced at a more rapid rate anywhere within our limits of audibility. This opens up an entirely new field of research, and may become a most important factor in the science of æsthetics. Perhaps it may demonstrate a numerical relation between harmony in music and in colours.

This feature of the Phonograph

may become of the greatest practical importance in telephony, by making it possible to carry on a number of conversations simultaneously over one circuit. The existing systems of duplex telephony are not, strictly speaking, duplex, for there is really a circuit for each conversation. By this phonographic multiplex system it would be possible to carry on one conversation in the ordinary way, then to have a phonograph transmitting a message at such a speed that the vibrations impressed upon the line should be below the audible limit of the ear, and, consequently, having no effect upon the original conversation. These slow vibrations could then be taken off upon a phonograph at the far end and reproduced at the normal rate. In the same way one or more separate messages might be transmitted at abnormally high rates and reproduced at the usual speed. Of course a multitude of practical difficulties exists, but there are no theoretical reasons in the way of this accomplishment. The working speed of the telephone line in the present state of the art is the most serious obstacle to be encountered. But this factor depends principally upon electro-static capacity; and while no scientist has as yet practically overcome the retardation that it introduces, the significant fact remains that no one can prove that this trouble cannot be avoided on circuits of ordinary dimensions.

Aluminium,

which has been termed the most wonderful metal of the age, has developed another latent quality, as a result of some researches by Professor Springer, of New York. This quality adapts it in a remarkable degree for use in the construction of sounding-boards. Professor Springer has found that it differs from all other metals, so far as he is aware, in being free from the comparatively continuous and uniform higher partial tones that give the tone-colour called metallic; and that it possesses an elasticity capable of sympathetic vibration uniform through a wide range of tone-pitch that renders it in that respect superior to wood. The thickness of the sheet may be so reduced as to obtain the utmost amplitude of tone vibration without injury to the quality of the tone; and in this it is superior to both wood and other metals.

Some of our Dangerous Epidemics

are undoubtedly transmitted from house to house by means of milk, which furnishes a good medium for their growth. It is admitted, however, that all the pathogenic disease germs which are likely to occur in milk may be killed by pasteurisation. Now, if pasteurisation is sufficient to kill the disease germs, and if at the same time it delays the souring from twenty to forty hours, and if the milk thus treated retains the taste of fresh milk, and permits the cream to rise on it in the natural way, it is plain that it is a process highly to be recommended. Pasteurisation consists in heating the milk to a temperature of about 155° or a little higher, and then rapidly cooling it.

Timing a Cannon Ball

by electricity has been engaging the attention of artilleryists with most successful results. A delicate electrical appli-

ance called the Boulanger chronograph measures the velocity accurately, and records its own measurements. This is the way it does it:

To Test Large Guns

two open frames are set up in front of the gun at a distance of 150 feet from each other. Wires are stretched back and forth across each of these frames, making a screen through which the projectile must pass. The wires in each of these screens form a complete electric circuit which includes also an electric battery and an electro-magnet. When the gun is fired the projectile breaks the wire in the first screen, interrupts the circuit, and at the same time the armature of the magnet is released. In a very small fraction of a second the projectile has covered the distance to the second screen and interrupted its circuit, releasing another armature. The interval of time between the drop of these two armatures represents the time taken by the projectile to travel 150 feet.

This Period

is so short that it is hardly conceivable. The chronograph, however, registers it accurately. Wires run from each of these screens to the laboratory near them, where are placed the chronographs, batteries, switchboard, and other apparatus. The two electro-magnets in circuit with the screens are embodied in the chronograph. The first magnet has as an armature an iron rod about three feet long, which is suspended in a vertical position from its core. When the wires of the first screen are broken this iron rod falls. When the shot ruptures the wire of the second screen the armature of the second electro-magnet, which is placed a short distance below the first, is also released. It operates as a knife, and striking the side of the falling rod makes a slight mark. The distance through which the rod drops while the shot is passing from one screen to the other is indicated by the distance of the cut from the end of the rod. From this the corresponding interval of time is easily computed, and this forms the unit for the calculation of the projectile's velocity in feet per second. When it is necessary to obtain very accurate records several chronographs may be used for testing the same shot.

The Rate of a Projectile's Velocity

diminishes rapidly during its flight from the gun, and the calculations of the initial velocity must be confined to a short portion of its path immediately after it leaves the gun. Instantaneous photographs may be obtained of the projectile as it strikes the target. From these experiments in velocity the ordnance officer is able to determine the relative strength of different powders.

A Hog's Stomach,

nasty as it may seem, yields the pepsin that is purveyed in the chemists' shops. A great deal of it comes from New York, and one factory has the oddest method of preparing the article that ever entered into the human mind. A number of perfectly healthy hogs are fattened for market, and for thirty-six hours before killing time are deprived of all food, not even being allowed a drop of water. Then the trough from which they are accustomed to eat is covered with strong wire netting, and the most appetising slops and hog delicacies, smoking hot, are poured into the trough. The fumes ascend with grateful fragrance to the porcine nostrils, the hogs all run to the trough and stand over it, ravenous with hunger, squealing and fighting with each other for a chance to get at the slops. The iron netting prevents them from tasting the food, and while they are still thinking about the matter they are killed, and their stomachs being taken out are found perfectly full of gastric juice, from which the pepsin is prepared. Now if it was not the hog's imagination that made the gastric juice flow into his stomach in anticipation of a feast, what was it?

Blue Devils

and bad weather usually go hand in hand—if the allegory is permissible—while bright weather and brisk temperaments are likewise of usual sequence. This is, of course, all due to atmospheric influence on those delicate little barometers, the nerves. Kingsley, careful observer that he was, dwelt expressively on this phenomenon "Barometer rapidly falling," he wrote, "Heavy clouds in the south-east. My heart sank into gloomy forebodings. Read 'Manfred' and doubted whether I should live long. The leaden weight of destiny seemed to crush down my aching forehead, till the thunderstorm burst and peace was restored to my troubled soul. The sun shines, you feel an inexpressible joy bound through every vein, and the soft air breathes purity and self-sacrifice through your soul, you feel your heart expand towards the universe. Organs of veneration and benevolence pleasingly excited; and you give a shilling to a tramp."

Nearly Every Man

carries his own hygrometer about with him, although the majority are ignorant of the fact. A watch may, however, be converted to this useful purpose without in any way affecting its time-keeping properties. In a civilised community, the value of a watch as a compass is not very great, but a man travelling about and occupying strange beds can protect himself from pneumonia by its aid. If there is a suspicion of damp about the sheets, lay the watch between them, and either smoke a cigar or read awhile. Then take out the watch, and if there is any film or moisture on the glass, don't go to bed, or if you do, sleep between the blankets, which are rarely damp. Hundreds of travellers, and especially men past youth or middle age, take this precaution and profit considerably thereby.

Arnica,

according to the popular idea, is a sort of liniment, compounded of various drugs, but it is nothing of the kind. It is the tincture or active principle of a European plant, a sort of weed, called by a German name, translated leopard's bane. It grows wild in Central Europe, though, of course, much better medicine is obtained from the cultivated variety, and either leaves, roots, or flowers may be used for the purpose of obtaining the valuable product, which takes its title from the botanical name of the plant. In Germany the peasantry simply boil the leaves or root and apply the liquor as a liniment, and the results are about as satisfactory as from the most carefully-prepared tincture.

A Moneyed Man,

who was looking yesterday at the process of laying an artificial stone pavement in front of one of his many properties, startled the friends who were standing about him by remarking:—"I believe that the Egyptian pyramids were built in just that way." Pressed for an explanation, he said that while he had never been in Egypt he had read the works of all Egyptologists, including Brugsch and Piazzi Smyth, and had never found in any of them a theory which would satisfactorily account for the manner in which the pyramids were constructed. "Now," he said, "you must remember that the pyramids are built of stone which bears no resemblance to anything found within five hundred miles of their location. It is incredible that the Egyptians of four or five thousand years ago should have possessed the mechanical ingenuity to move these enormous blocks of stone from the granite quarries of Abyssinia or Syria to the pyramids. Is it not much more natural to suppose that the ancient Egyptians possessed the secret of making artificial stone, and that the pyramids were constructed by layer upon layer of Nile River mud, hardened by just such processes as we employ to make artificial stone? It is a much more plausible explanation of their construction than the laborious and unintelligent suppositions that the stones were carried across the desert to form the foundation and base of the pyramids. I firmly believe that the Egyptians of the ante-Christian era understood the manufacture of artificial stone, and that they built the pyramids out of it."

Under the Sun

there is nothing new! According to the testimony of several ancient historians, there was a small ship canal existing at Suez 600 years before Christ, which was used for nearly a thousand years. It is also believed that there existed another canal from the Nile to the Red Sea. The shifting sands of the desert ages ago destroyed all traces of these engineering works; and those enterprising travellers who fancied they discovered the outlines of both were probably misled by natural declivities and hollows scooped out by the winds. The idea of re-opening the canal on a grand scale is due to Napoleon I., who suggested the propriety of the step, but, like many others of his mighty schemes, it came to nothing. The present canal was planned by De Lesseps in 1852, the work was begun in 1858, a small vessel drawn by tugs passed through in 1865, and the canal was formally opened in 1869.

Can Colour affect Insanity?

Effects of the variously coloured lights on insane persons have been observed by the director of the Milan Insane Asylum. A melancholy patient with a rosy light improved perceptibly in twelve hours. In twenty-four hours he called for food, although for many preceding days nourishment had been administered to him against his will. Thereupon the director had rooms furnished in solid colours, and confined patients in them. Green and blue were found to be the most quieting; rose the most cheering; and red the most exciting. All the patients in the Asylum will be confined hereafter in apartments furnished in colours to suit the nature of their maladies. Does this tend to show that colour is a sensation, or that the action of the retina affects the brain, and, consequently, the nervous system?

How to save the Eyes

from evil effects of the electric light would soon cease to be matter for discussion, if a little more common-sense could be brought to bear upon its use. Many think—because an incandescent lamp does not give out much heat and will not singe their whiskers or their hair—that they must have the lamps right under their nose, or half a foot away from their eyes, and directly level with them. This sort of thing would be injurious even with a glow-worm lamp, if there were such things. Incandescent lamps require to be properly placed and shaded, so as not to cast their rays directly on the eyes. These precautions would entirely obviate any danger to the eyesight.

The effects of the Electric Light on the Eye

are not as well known as they ought to be, and now the light is becoming so universal, a few remarks on the subject may prove interesting. Most people who use the incandescent light like a new lamp, because the light is white, and more brilliant than after the lamp has been in use for a short period. This is wrong. It is the dazzling white light that injures the eyes. An old lamp is the best, for in these the light has become changed to a pale yellow, which is the ideal colour. Just as in noonday brightness, human sight is not so clear and far-reaching as at the yellow sunset, so a new incandescent burner is not so good for the eyes as an old one. An old burner, so adjusted and shaded that the light from it does not shine in the face, is the ideal artificial light. The use of the arc light should be confined to street lamps. Some shopkeepers still use them, but they are terribly hurtful to the eye. This is because the intensity of the light is constantly changing, and the jumping of the blaze is much worse for the eye than the flicker of the gaslight. A great many people are constantly being treated for inflammation of the retina, caused by working by the light of arc lamps.

What is Matter?

We are all told that matter is made up of molecules, and that the distances between molecules are immense compared with their size. If we could conceive a being small enough to exist on a molecule and he should gaze off into space, the nearest molecules would appear to him at such distances as the stars do to us. The idea of a grain of sand containing worlds of its own is too stupendous even for a poet. Yet who can say that such is not the case. Then, to turn to the other extreme, suppose the earth to be an atom, our solar system, and, perhaps, our universe, forming a pebble on the shore of some vast ocean space!

A Hundred Years Ago

many astronomers believed that some of the planets were inhabited, and a few of them thought that even the sun was peopled. Later scientists reject these notions. At all events the larger planets are probably still too highly heated to support life such as exists upon the earth. The astronomers of to-day confess that they have no good reason to suppose that any of the planets, great or small, contain any sort of organised beings. In addition to the recent bequest of a French lady to be given to anyone who can communicate with Mars, a German capitalist has offered a reward of £5,000 to any astronomer who can satisfactorily prove to

him that the sun, the moon, or any one of the stars is inhabited, or that it contains any solid matter whatever. Many prizes are awaiting the advance of science.

The Influence of the Mind

on the body is often amusing and always instructive. Some years ago Dr. Woodhouse Braine was called upon to give chloroform to a nervous hysterical girl for the purpose of having two tumours removed from the scalp. In order to accustom her to breathing through the inhaler before giving her chloroform, he placed it over her face and she at once began to breathe rapidly through it. In half a minute she said, "Oh, I feel it; I feel I am going off." Immediately after she was found to be insensible to pinching and her muscles were flaccid. Both tumours were removed without her having taken a drop of chloroform, and after the operation she declared she had not felt a particle of pain. The doctor very facetiously remarks; "To the time she left the hospital she firmly believed in the potency of the anæsthetic which had never been administered."

Idiots,

according to Esquirol, without the power of speech can sing. Dr. Wildermuth, of Stettin, compared 180 idiotic children with 80 normal children in regard to vocal range, sense of harmony, and memory for melody; and 27 per cent of the idiots and 60 per cent of the normal children were classed as musical in the highest degree; 11 per cent of the idiots and 2 per cent of the normal children were without musical ability. This remarkable relative development of the musical sense in idiots is the more striking as there is no evidence of any other artistic taste. The practical outcome of Wildermuth's observations is to emphasise the necessity of vocal culture in the training of idiots.

The Right Arm

is nearly always a little larger than the left, but the left foot is almost always larger than the right, presumably, because, while nearly every man uses his right arm to lift a weight or strike a blow, he almost invariably kicks with his left foot, while the lounger stands on his left leg and lets his right fall easily, because he has learned by experience that this is the best attitude he can assume to prevent lassitude and fatigue. This constant bearing of the weight on the left foot makes it wider than the right, and it often happens that a man who tries on a shoe on his right foot and gets a close fit, has to discard the shoes altogether because he cannot endure the pain caused by the tightness of the left. If, when riding in a public vehicle, you take the trouble to notice, you will see that in laced shoes the gap is much smaller on the right foot than on the left, while with button shoes the buttons have to be set back ten times on the left shoes to once on the right. The moral, of course, is never wear shoes not made to order, and always have both feet measured. But if this is too sweeping, always try on the left shoe and trust to luck for the right.

Coming Events

cast their shadows before them, and many superstitious people cannot accept this in the figurative sense, but are always looking out for actual shadows. The grotesqueries nightly painted on respectable walls and basements by the electric light are to these people portentous omens for good or evil. Shadows are only shadows, but they give some people the shivers sometimes, especially at a late hour when honest folks are supposed to be in bed. Giants of despair then stretch out long arms at the corners of silent streets, and strange profiles are thrown against the unconscious houses, and weird traceries of dancing branches make the pavement rise and fall in a style that must puzzle a person who knows he is sober. Alone, without the presence of humanity, these electric shadows lend the sleeping city a mystic animation that even conventional moonshine fails to dispel. The sputter, the swish of the lights, too, add to the uncanny effect, and their fluctuations would in time drive the sane mad if thought was taken of them. Luckily, man can accustom himself to almost anything.

The Fasting Mania,

to which so much attention has been drawn by the recent performances of Jaques and Succi, is at least three hundred years old. In the Public Library of Geneva a book published at Basle in 1577, contains the account of a faster named Henry, of Hasselt, who for the mere whim of the thing existed for forty days and forty nights without taking solids or liquids in any form. The bona-fides of the performance was vouched for by the Governor of the province, who caused the man to be kept in one room and carefully watched.

Anti-Tobacconists

may, perhaps, relent of their wrath on reading the following experiments:—M. Tassinari, of Paris, recently blew both cigar and cigarette smoke into the recess formed by two funnels placed mouth to mouth, and in which were suspended, by means of a platinum thread, a shred of linen containing the microbes under examination, The experiments lasted from 30 to 35 minutes, 5 grammes of tobacco being used. The linen was then placed in a tube containing gelatine. M. Tassinari found that the smoke of three brands of cigars retarded the developments of the microbes, and completely destroyed the Asiatic cholera bacilli of Finkler and Prior and those of typhoid fever. It was found, however, that cigaratte smoke retarded the development much more slowly. We are thus able from these experiments to reconcile the statements of some American physicians that habitual smokers suffer immunity from the attacks of yellow fever.

Telegraphy

is a matter of astonishment even to our present-day progress, but the vagaries of the telegraph clerks are even more puzzling. If a stock-broker telegraphs to his wife that he is not coming home to dinner, he allows at least half an hour for the message to reach its destination. On the other hand, if the same broker cables his broker in New York and doesn't get an answer in less than five minutes he considers himself an ill-used man. Incredible as this seems, it is a fact that a London stock-broker can cable a message to his agent on the New York Exchange and get an answer in four minutes. There are an average of 800 messages sent daily between the London and New York Stock-Exchanges in this way. On occasions they have been delivered and replied to within 3 minutes.

Electrocution Experiments

would seem to be pretty prevalent on the other side of the Atlantic. Luckily for the experimentalists the subjects usually escape with life. A Texas man who survived a 500 volt shock thus describes his sensations: "Just as the shock came it seemed to me like a blinding flash of lightning had come and its lurid flame had struck and remained in my eyes. I then felt myself reaching upward and as though I was going to fly; this, I suppose, must have been the sensation caused by the contraction of my muscles. Then I felt as though I was soaring away, just as one feels when put under the influence of ether or chloroform. Then all was blank and I knew no more until I felt a pricking sensation in all of my members. I then felt a strong taste of brimstone in my mouth, just as I am told that those who are struck by lightning experience always." Thus, the unfortunate culprits who suffer death in this fashion receive a very early taste of brimstone.

"L" Roads

will, we hear, soon exist in England. For the information of those of our readers who have never visited the United States, we may mention that these roads are railways running overhead on specially-constructed lines in American streets. They were originally called "elevated railroads," and then our cousin's natural predilection for brevity induced him to talk of the "elevated," and now he only says, "I guess I'll go by the "L." The English "L" road to which we have referred, will be constructed at the Liverpool Docks, and will be used for local passenger traffic and for goods traffic to the numerous docks and warehouses. It will be about 6½ miles long, with stations at short intervals and frequent trains, and the construction will cost about £400,000.

The Luxury of Electricity

in our domestic arrangements can only be appreciated by a visit to such an establishment as that of Patti at Craig-y-Nos. The castle is lighted by electricity, electric motors are used wherever possible, and private telegraph and long-distance telephone lines connect the castle with London. In the billiard room is a £6,000 orchestrion operated by electricity. It is as delicate as a human voice and very often the maker is summoned by telegraph from Germany to adjust it. The new theatre which Patti has just built near the castle will accommodate 300 people. It has the regulation slanting floor, but this is so arranged that it can be raised or lowered to any desired position by means of electric motors. The electric light and power station is a handsome stone building situated at a little distance from the castle. A most complete system of electric burglar alarms protects the castle from uninvited intruders. Truly, a wonderful palace.

The Human Frame

is an excellent magnet. This fact has been observed much to the disgust of the watchmakers. A man will carry a watch for years and be proud of its accuracy. Then he will fall sick, the watch will lie about unused, and will develop great inaccuracy and unreliability. No explanation is forthcoming except the one that the absence of magnetism upsets the time announcer, and the best proof of this is that when the man is once more well again and carries his watch, it soon gets all right. No two men appear to have the same magnetism in their frames, and it is seldom that two individuals can use the same watch satisfactorily. A watchmaker tells us of an instance in which a watch was constantly coming in to be cleaned, regulated, or repaired, with no explanation and nothing amiss. At last he found out that his customer and a friend were doing the Box and Cox act—one working at day and the other at night, and using not only one bed but also one watch in common. The watch could not stand the double duty, and the morning and evening change in the magnetic force always affected it, and it was not until one man only used it that it could be persuaded to be reliable. Purchasers of second-hand watches should consider this point, and be slow to condemn a watch which at first does not seem to go accurately.

Petrifaction

of the human body, according to the majority of scientific authorities, is an impossibility. The human body is composed, for the most part, of materials which, without the principle of life, fall into decay in a wonderfully brief space of time, and, save the bones, retain no resemblance to their original form. The process of petrifaction is supposed to require a very long time, and before it could be fairly begun all semblance to a human body would be completely lost. The bones of the skeleton may become fossilised or converted into stone by silicious deposits, and several well-authenticated instances have been noted in which this remarkable change undoubtedly occurred. The position taken by scientists is entitled to respectful consideration, but, on the other hand, it is perfectly well known that there are fossilised remains of fish, thousands of specimens having been found, while fossil plants and leaves, the texture of which must have been far more delicate than that of human flesh, are found in every coal mine and in many other localities. Numerous and apparently well-authenticated instances of the fossilation of the human body have been reported from time to time, and it is possible that when placed under peculiar and very exceptional circumstances the phenomenon might occur. Several noted frauds in this connection, however, have not yet faded from public recollection, and tend to throw discredit on stories of the fossilization of the human body.

In Beginning to Sleep

the senses do not unitedly fall into a state of slumber, but drop off one after another. The sight ceases, in consequence of the protection of the eyelids, to receive impressions first, while all the other senses preserve their sensibility entire. The sense of taste next loses its susceptibility to impression, and then the sense of smelling. The hearing is next in order, and last of all comes the sense of touch. The sense of touch sleeps most lightly and is the the most easily awakened; the next easiest is the hearing; the next is the sight, and the taste and smelling awake last. Another remarkable circumstance deserves notice. Certain muscles and parts of the body begin to sleep before others. Sleep commences at the extremities, beginning with the feet and legs and creeping toward the centre of nervous action. The necessity for keeping the feet warm and perfectly still as a preliminary of sleep is well known. From these explanations, it will not appear surprising that, with one or more of the senses, and perhaps also one or more parts of the body imperfectly asleep, there should be at the same time an imperfect kind of mental action, which produces the phenomenon of dreaming.

GLEANINGS OF THE GLOBE.

It has been lately pointed out that the air is much contaminated with arsenic, especially in English cities, from the burning of coal.

Every year a layer of the entire sea, fourteen feet thick, is taken up into the clouds. The winds bear their burden into the land and the water comes down in rain upon the fields, to flow back through rivers.

The sun is 92,500,000 miles from the earth. The latter receives only one-billionth of the solar heat. The nearest fixed star is 16,000,000,000 miles distant, and it takes three years for light to reach the earth.

A very ingenious instrument has lately appeared for showing the velocity and the pressure of the wind. The effect is produced by the rising or falling, in level, of mercury in a trough.

The danger of conveying infection by lancet or needle having been pointed out, a French surgeon proposes vaccinating with ordinary steel pens, specially pointed. Being inexpensive, a fresh pen can be used for each operation.

Dr. M. C. Cooke, of London, finds that 4,600 species of mushrooms and toadstools are now known to science, 1,400 of them being found in the British Isles. Only 134 can safely be regarded as edible, while 30 are decidedly poisonous.

The human heart is 6 inches in length, 4 inches in diameter and beats an average of seventy times per minute, 4,200 times an hour, 100,800 times per day, and 3,681,720 times per year. So in a life of 80 years the heart beats 300,000,000 times.

A new shell has lately been invented by an Austrian for the purpose of scattering oil over the waves during a storm. It is a wooden cylinder lined with shellac to keep the oil from penetrating the wood, and it carries in addition a calcium light, which illuminates the water for a considerable distance.

Consumption has been produced in guinea pigs by inoculation with tubercle bacilli obtained by Herr Prausnitz in the dust of cars often used to convey patients from Berlin to Meran. The number of bacilli is supposed to have been small, but the necessity of disinfecting the cars used by the sick is shown.

Artificial bitter almonds are now produced at a trifling cost, and with such deceptive skill that they can scarcely be detected when used as an adulterant of the genuine. They consist chiefly of grape sugar. This is flavoured with a very small quantity of nitro-benzole, and when pressed in moulds the product is made to resemble the natural seeds very closely.

How many people who look at a Fahrenheit thermometer know why it is divided into 212° between the zero and boiling point. It is fairly well known that Fahrenheit established his zero at what he believed to be absolute cold produced by a mixture of ice and salt, but the 212° is a puzzler. Considerable search has resulted in the following reason :—Ten thousand volumes of mercury at the Fahrenheit zero are 10,212 volumes at the boiling point of water. In some way or other Fahrenheit hit upon this fact, hence his scale.

The expression "worth its weight in gold" is the outcome of the notion so generally accepted that gold is the most costly metal or, indeed, substance known. This is a mistake no scientific man is ever betrayed into, because there are at least twenty substances worth more than the yellow monetary standard. Berylium, for instance, is worth just about ten times its weight in pure gold, and vanadium is five times as costly as gold. Although neither of these substances is in common use, every one who has used a gold pen knows what iridium is, and iridium is worth more than double what gold is. In children's text-books it is often said that the only metal more valuable than gold is platinum, which used to cost much more than the "precious metal," but which now costs just about the same. It may be news to many that it is possible to find a raw metal worth very much more than its weight in gold, but it is a fact none the less.

Dentists have discovered that tartar, the calcareous deposit on the teeth, is more abundant in persons of highly nervous temperament than in any others. The explanation, according to an observant dentist, is that persons of nervous temperament secrete more saliva than others, and as tartar is carried by saliva in solution, the deposit in the case of such persons is unusually large. It is a well-known fact that the nervous condition has a marked effect upon the salivary glands. An Oriental method of detecting crime is to take several persons suspected of the offence and require them to chew dry wheat. The nervous fears of the guilty man seal up his salivary glands and he chokes in attempting to reduce the grain to pulp.

A phonographic dictionary may be considered among the future possibilities of the phonograph. It will, probably be so constructed that the busy correspondent, by simply touching a button, may have any word properly spelled, pronounced, and defined, with the usual etymological data appended, all given in the most approved tones of the elocutionist's art ; a phonographic porter who will clearly enunciate the names of railway stations ; and a clock which will call out the hour and minute on a button being pressed. We think, however, that the musical world will most benefit by the perfected apparatus.

A curious and interesting calculation has been made by Professor Rogers, of Washington, D.C., on the dynamic power of coal. According to the professor, a single pound of good steam coal has within it dynamic power equivalent to the work of one man for one day. Three tons of the same coal represent a man's labour for the period of twenty years, and one square mile of a seam of coal, having a depth of four feet only, represents as much work as one million (1,000,000) men can perform in twenty years ! Such calculations as the above may serve to remind us of how very wasteful our methods of burning fuel must be, in spite of all that has been done by inventors in the way of economy.

THE PRIZE SCIENCE SIFTING.

One Guinea will be paid each week to the contributor of the most interesting Scientific paragraph.

The paragraph must be written on a postcard, and need not be original, but in this case, the source from whence it is copied must be given. All paragraphs must reach us on Monday.

The Editor reserves the right of publishing any paragraphs sent in.

Blood is Life.

"Dust thou art and to dust returnest." The earth produces food, food becomes blood, and blood is capable of diffusing life and vitality to the organisation of which it forms a part. It is a wonderful fact that the dead matter which, but a little while ago, was being ground by the teeth, softened by the saliva, and solved by the gastric juice and bile, has now acquired life. Nobody can tell the precise stage or moment when it began to live. But somewhere between the stomach and lungs it is changed from the dead to the living state, and now forms part of the vital fluid of the system.

A Reason for Red Sunsets.

The reason for the red sunsets indicating a fine day to come is because the amount of vapour floating in the air refracts the beams of the sun and more freely transmits the red rays of light than the coloured rays. It is the degree of moisture in the atmosphere which affects the refraction of the light, and when the red rays of evening are freely transmitted the amount of moisture does not approach the rain point, and, therefore, promises the following day to be fine.

How the Earth Vanishes.

A French geologist has made a careful calculation of the amount of solid matter yearly carried off into the ocean by the action of the rivers of the world and other causes. He estimates that the reduction of the average height of the surface of the solid land is 0·0006 inches each year. Making allowance for the corresponding rise in the bed of the ocean, and taking no account of the occurrence of volcanic or other exceptional phenonema—the general tendency of which is to hasten the progress of disintegration—the period at which the solid land will have ceased to exist and the surface of the earth will be covered with water has been estimated. As, however, that period is 4,500,000 years distant, the prediction need cause no immediate disquietude.

What will become of the Caspian Sea?

Counting from the sea level, the lowest body of water on the globe is the Caspian Sea. For centuries its surface has been gradually setting down until now it is eighty-five feet lower than that of its near neighbour, the Black Sea, which also lies far below the level of the ocean. The common conclusion has all along been that the Caspian Sea was merely losing its waters by some means, but recent investigations have shown this not to be the case. Soundings made and compared with records of soundings made more than 100 years ago, reveal the astounding fact that there is still as great a depth of water as existed then. This leaves but one hypothesis that would seem to be tenable: The bottom of the Caspian Sea is actually sinking. There is much speculation in scientific circles relative to what the final result will be.

NERVES AND NARCOTICS.

Excessive, exhausting, and too long-continued work, insufficient or irrational recreation, and deprivation of the right amount of sleep are some of the main causes for the increase of nerve troubles in our day. The competition in all the professions and callings is so great that for every person whose powers fail, ten are ready with fresh strength to perform the same or greater labour for the same or even a smaller remuneration. All exciting and weakening amusements should be done away with, and the quiet joys of family intercourse, the conversation of intimate friends, and sociable walks in the fields and woods should take the place of brilliant evening assemblies. Then every person should pursue some agreeable occupation besides his regular profession, and in the latter he ought to have frequent hours of relaxation to relieve the strain. Mental application, even for healthy adult persons, ought not to be continued for more than three or four hours at a time, and night work it would be best to avoid altogether, as the excitement is apt to interfere with sleep.

All who follow intellectual pursuits ought to have several weeks of complete rest at least once a year. Sleep is, however, the principal agent of recuperation. The amount of sleep needed is different for different purposes. For the ordinary worker from six to eight hours is absolutely necessary; yet how often, in the battle for existence in our time, is the desire for sleep forcibly suppressed and the night's rest improperly shortened. Sooner or later insomnia wreaks its vengeance on the offender. Many a person who once robbed himself of the necessary amount of sleep would gladly sleep now, but cannot. We do not hesitate to say that nerve troubles first develop into disease when joined with sleeplessness. It appears as a latter symptom of a long-standing nervous disturbance, but to the lay mind it appears as the first sign of disorder, and is frequently taken to be the cause. The worker of the nineteenth century, works beyond his strength, and in order to keep it up he resorts to stimulants—coffee, tea, spices, alcohol, tobacco. These produce a super-excitation of the nerves, which brings in its train insomnia; and to overcome this he resorts to narcotics. The life of many of our contemporaries consists in taking artificial stimulants to enable them to perform their work, and then resorting to powerful narcotics that can counteract the artificial stimulation and produce rest and sleep.

Anyone can see that this alternation of stimulation and depression, at least once every twenty-four hours, must weaken the nervous system. Coffee is a powerful stimulant for the heart, and, therefore, those who suffer from palpitation, from hysterical conditions or from insomnia, should avoid its use. Tea in the day time acts more mildly on most people; but taken at night it drives away sleep. The spices are less active nerve stimulants; yet pepper, especially, and some of the others affect the nerves of the digestive organs powerfully, and their liberal use in modern cookery has something to do with the epidemic insomnia. Of the injurious, the actually destructive effects of alcohol taken in excess, little need be said. Physicians are not a little to blame in that they insist on giving large quantities of alcohol in fevers and conditions of exhaustion, not to speak of the methods used to cure the morphine habit, until patients often acquire the drinking habit. The evil results of the abuse of alcohol are not often apparent. Long before delirium tremens or other serious brain

diseases appear, they are preceded by manifold nervous disturbances, the real cause of which is not often understood. We have frequently found that rheumatic pains that were ascribed to a cold were nothing but alcohol neuritis, a mild form of inflammation of the nerves resulting from the use of alcohol, which disappeared when the practice was given up, only to return with the slightest repetition of the indulgence. Most habitual drinkers, and some of them very early, are subject to changes in the vascular organs, such as fatty degeneration of the heart and arterio-sclerosis, which lead to grave affections of the nervous system, like apoplexy and softening of the brain. Finally, it may be taken as proved that the children of drunkards, if they are not carried off prematurely by brain troubles, are frequently afflicted with serious nervous ailments, such as epilepsy, idiocy, and the like.

Tobacco has come to be in our time a national poison in many countries, and most especially in Germany. As sequels of chronic nicotine intoxication may be noted without fear of contradiction :—Palpitation and weakness of the heart; irregularity of the pulse, of which heart pang or *angina pectoris* is an acute symptom; general nervous debility; tremulousness; disturbances of vision, even to the point of blindness: and hypochondriacal depression even to the degree of melancholia. The fear-inspiring intermission of the pulse is a frequent cause of inveterate insomnia. That the children of heavy smokers suffer with uncommon frequency from nervous diseases is an established fact.

And now for the narcotics, at the head of which stands morphine. The great danger of falling into the habitual use of this drug arises from the cowardice and degeneracy of our times. No one will suffer pain, no matter how slight or transitory. Not a tooth can be drawn, not a child born into world without the use of an anodyne, and when death comes we must have euthanasia. It is said that many physicians lend their hands too willingly, and are ready with the injecting needle to check a pain that could easily be borne, not reflecting that it is immoral to encourage effeminacy and a dangerous thing to plant the germ of the morphine habit, a terrible passion that leads inevitably to physical and spiritual debility and to death. The same is true of the constantly increasing cocainism and hasheesh intoxication. Our generation demands above everything narcotics to produce the sleep that first we drive from us, and afterward so fondly desire; anti-pyrine, phenacitine, opium, morphine, chloral, bromide of sodium, paraldehyde, hydrate of amyl, urethan, sulfonal, hypnon, somnal, and whatever are all their names—one would think names would soon give out, so fast are these children born. But how can we sleep without resorting to soporifics! Just as the life of the soul during the day is reflected in dreams, so the conditions of sleep are determined by all that we do when awake. The chief rule is to so act waking that you can sleep. Begin by accustoming yourself to do without excitants. Many a case of sleeplessness has yielded, when all other means failed, to restricting or totally abandoning for a time the use of spirituous drinks, coffee, tea, and tobacco.

The power of the muscles may be measured with as much facility as the height. A Frenchman has constructed a machine that will thus measure any particular muscle or group of muscles. The apparatus registers the power on a band of travelling paper, and is likely to be very useful in physiological science. Experiments made with it at the Museum of Natural History in Paris have shown that the muscular power of the biceps and of the anterior brachial muscles in man varies as much as from 15 to 45 kilogrammes.

THE JOURNEY OF LIFE.

The whole journey of life is best divided into three stages—the period of ascent or youth (1-25); that of level ground or maturity (25-50); and that of descent or decline (50-75). Old age may set in anywhere along the last stage. It must not, however, be supposed that the last stage necessarily ends at 75; for, of late years especially, in many cases the period of old age has not begun until 80 years are past, life being prolonged over the century; while, on the other hand, all the signs of old age have been seen before 20 years have been reached. Out of every 1,000 people, nearly 100 reach 75, 38 reach 85, and 2 reach 95. The number of persons in proportion to the whole population that reach 70 in Norway is one-third, in England nearly one-fifth, in France one-eighth, and in Ireland one-eleventh. As far as can be calculated, the average length of life, which is computed in the seventeenth century to average only 13 years, is in the eighteenth increased to 20 and in the nineteenth to 36. Men used to be considered old when they passed 50.

It is interesting to compare the age of man with that of other parts of the organic kingdom. In the vegetable world it is enormously exceeded. Among trees, the elm reaches an age of 335 years; the ivy, 450; the chestnut, 600; the olive, 700; the cedar, 800; the oak, 1,500; the yew, 2,800; while Humboldt computed the age of a baobab tree (a species of banyan) to be 5,700 years! Among fish, Dr. Richardson finds no deaths from old age, and does not believe that they have any term to their lives, save as they fall a prey to one another. Carp and other fish that have been isolated and watched are still living at enormous ages. As long as they live they increase in size. Among animals, we have an elephant of the reputed age of 1,007 years. Coming to men, we find many remarkable instances of longevity. The long lists given by the old writers of very aged people (including one of over 300 years of age) have been proved to be most unreliable. Many cases, however, are beyond suspicion, and such an unimpeachable centenarian as Sir Moses Montefiore silences all sceptics who doubt that human life can attain to three figures. Old Parr still remains as one of the most wonderful of these veterans. He was a poor farm servant, and like Henry Jenkins (who was supposed to be 160 years old at death), led a hard and laborious life in a country village on scanty fare. At 120 Parr married a widow for his second wife, and at 130 could thrash corn. He died at 152, but not of old age.

Longevity appears to depend to a certain extent on country and climate. While a cold bracing climate like Norway gives a very high general average of age, the climate of Western Italy seems most favourable to very advanced life. As early as A.D. 76 we find that in this district, in the emperor's census, 54 were returned at 100, 57 at 110, 2 at 125, 4 at 130, and 3 at 140. In Ireland, though the general average is low, we get many instances of centenarians. A country life is conducive to old age, while it is extremely rare to find persons of 90 years and upwards who have led sedentary town lives. Longevity cannot be said, however, to be dependent on any condition or vocation, but is found in the most opposed circumstances. St. Anthony, who died at 105, ate a few ounces of bread soaked in water, never washed or changed his garments, and lived always alone in a desert. M. Chevreul, the great French chemist, at nearly the same age, ate for breakfast two eggs, some chicken pasty, and had a pint of *café-au-lait* daily; for dinner, tapioca soup with grated cheese, a cutlet, a bunch of grapes, cheese, and three glasses of water. No fish and no wine. He was scrupu-

lously clean, and lived in or near Paris. Some people survive in spite of their habits. One old man of 97 all his life drank quantities of neat gin and smoked the strongest and rankest tobacco; while the Rev. W. Davis, who died in 1790 at 105, and who ought to have known better, for the last 35 years of his life never took exercise, and began the day on hot buttered rolls, and ended it with a supper of hot roast meat, with plenty of wine. Spinsters will be pleased to know that single women live as long as do married. Sex influences old age. In 1873, out of 89 dying at or over 100, only 10 were males. This is due partly to less exposures to injuries and partly to greater tenacity of life. Girls die more slowly than boys: and though more boys than girls are born each year, this difference maintains the balance.

We may notice one or two other points of comparison between the sexes, as observed in some hundreds of recorded cases lately collected. The average height of an old man over 80 is 5 feet 6 inches, of an old woman 5 feet 3 inches; the pulse rate in the man is 73, in the woman 78; the breath rate in the man 18, in the women 22. The average number of teeth in the man is 6, in the woman 3; while a fourth of the men and half the women had none at all. It is believed that there are traces in the animal kingdom of a law that fixes the extreme duration of life at five times that of growth. This latter period in man may be said to average 21 years. Hence the full span of a perfectly healthy man's life should range from 100 to 105 years. As, however, none are born perfectly free from taint, the expectation of life varies greatly. Every human being starts on his life's journey with a certain life-force; or, in other words, like a clock, he is constructed to run a certain time under given conditions. In 500 cases of people over 80, most came from long-lived families, enjoyed good homes, good appetites, and good digestions; were moderate or small eaters, consumed little alcohol or medicine, were good sleepers, and showed at death no trace of gout or rheumatic gout. Nevertheless, in 82 cases the near relatives were consumptive.

MEASURING BRAINS.

Mr. J. L. Balbi says: It is well known to the medical profession that every mental effort causes a rush of blood to the brain, and that the amount of blood depends on the "intensity" of the thought; but rush of blood means a rise in temperature, and if we could measure this we would be able to determine, in a *rough* way, the "power" necessary for the generation of any thought or mental effort. I accomplish this object in the following manner; I have a head gear of some light, high-conducting (heat) substance. In its middle or any other convenient position I fix a thermo-electric pile, and connect this, by means of flexible wires or otherwise, to a sensitive galvanometer. The extreme sensibility of the thermo-electric pile is well known, and therefore whatever rise in temperature takes place, consequent to the rush of blood, would be instantaneously indicated by the galvanometer. The utility of such an apparatus may not appear at first sight of great importance, but if we consider for an instant the facility or difficulty with which children at school learn their lessons, any doubts we may have entertained as to its practicability will be immediately dispelled. By such a contrivance would we ascertain the "brain power" of boys and girls, nay, even men, and thus be in a position to indicate in what direction their mental efforts ought to tend.

PHRENOLOGY EXPLAINED.

By Stackpool E. O'Dell.

Author of "Phrenology: its Truthfulness and Usefulness," "Old St. Margaret's," "Merciful or Merciless?" "Brompton Lectures," "Mental Troubles," etc.

II.

The fundamental basis of Phrenology is that the brain is the physical organ through which the mind manifests itself to a physical world. This has been proved by many facts derived from observation, a few of which are the anatomy of the brain, the results of vivisection, more especially those of Ferrier; the diseased conditions of the brain, and both its normal and abnormal state. The simplest and yet most positive proof that the brain is the organ of the mind is the comparison between extremely large and extremely small heads. As the brain capacity of the skull decreases, so we perceive an increase in mental manifestation, other things being equal. For instance, if one individual in a house has a head larger than another individual, and the quality and activity of both brains are similar, we expect to find that the one with the larger head will in some direction show most mental power. We know that it has been very properly stated that men whose heads have been below the average have manifested more than an average intelligence. Yes, we reply, but there will be a certain portion of the head commensurate in size with the intelligence, and it is the other portions that will be deficient, thus making on the whole a small head. For instance, if a man possesses that portion of the head large where the organs of time and tune are localised, there will be musical capacity of much greater power than that of a man who may have a large head in all other parts except these. The circumference of an average English head is twenty-two inches. If the head reaches twenty-three it is large. If below twenty-two it is small, or very small.

The next important consideration is the quality of the brain, its degree of fineness or coarseness. Generally speaking, to the experienced eye, the external appearance of all things in Nature denotes the internal condition. The woodman knows the condition of the tree by its bark. So does the gardener know the fruit, whether it is sound or sweet. The internal qualities of the horse or the cow are known from their skin or hide. The physician can discern disease or health from the external appearance of his patient, so does the phrenologist discern the quality and condition of the brain from the texture of the skin, texture and colour of hair, colour of eyes, and general temperament.

The third consideration is the localisation of various organs through which, as a medium, the mind manifests its desires. We have seen in the previous article how the soft brain forms the hard skull, so that the external formation of the head is an indication of the internal size of the brain, where it is large and where small. From much observation it has been discovered that the formation of the head is an indication of the direction, the weakness, or the strength of the mental powers. For instance, in accordance with the width of the head and its prominence immediately over the eyes, we have perceptive power, or power to learn from observation. In accordance, as the head is large in the region of the forehead, large in regard to both width and protuberance, we discern intellectual power. In accordance with height and width in the coronal region on the top of the head we have moral sentiments and moral power. Just as the head is long and

wide at the back, so do we expect a manifestation of the social faculties. Width between the two ears denotes executive power, determination, energy, force. In these various portions of the head which we have pointed out, we have groups of organs, the purposes of which we have indicated. These groups have other divisions, which, when all counted up, map out the external surface of the head into forty-two regions, each region being an organ denoting some special mental characteristic. In our former article we have shown upon the authority of scientific investigators that the localisations of these faculties are plainly discernible, and must be accepted by those who, free from bias, will study the matter. All the faculties of the mind are intended for useful and beneficial purposes. We have not yet discovered a faculty which is in itself bad when made a legitimate use of. In accordance with the teaching of Phrenology, whatever a man does that interferes with his happiness or that of others is the result of the illegitimate, mistaken, or ignorant application of some one or more faculties. These faculties generally act in combination, the largest of them leading the others. To find out how they combine, for what purpose they combine, and which leads, is of great importance to each individual.

THE MYSTERY OF DEATH.

What is death? Philosophers have concerned themselves much with attempts to define death. Life, says Mr. Benjamin Taylor, we know in some sort, but death is an absolutely unknown quantity. That which is mysterious is always more interesting than that which is patent even if uncomprehended. Life is familiar, but death must always remain a mystery and an unsolved problem to the living being. When Faber wrote: "Death is an unsurveyed land, an unarranged science," he expressed what still remains the sum of our conceptions. The best that can be said for this definition is that it is at least as near the mark as any other. But does it bring us any nearer to a knowledge of what death is, to be told that it is simply a want of that "correspondence" of relations which is defined as life? The mystery of not being still remains greater than the mystery of being. When Socrates suggested that pleasure is a state of not pain, the mind can more readily grasp the significance than in a thesis which declares that death is not life. But Socrates, as we know, argued that while life is contrary to death, death is produced from life and life from death. "What is death," says Seneca, "but a ceasing to be what we were before?" "And where all life dies," says Milton, "death lives.' Which may all be accepted without in the least enlightening us about "the strange, mysterious power, seen every day, yet never understood but by the uncommunicative dead." Humboldt owned that he had never known the feeling of an anxious longing for death, yet held that death is not a break in existence—it is but an intermediate circumstance, a transition from one form of our finite existence to another. "The sense of death is most in apprehension," and the apprehension is more general than Southey would have it, for he declared as the result of his observations that the fear of death is not common. Where it exists, he said, it proceeds rather from a diseased and enfeebled mind than from any principle in our nature. But he is surely wrong, for it is an ineradicable principle in our nature to fear the unknown, even while we most zealously strive with it.

WHAT IS GENIUS?

A correct definition of the word "genius" has been one of the long-felt wants of English literature. Whole pages have been written explaining the difference between "talent" and "genius," but their perusal leaves us no wiser than we were. Dr. Samuel Johnson said that genius was "a large power operating in a particular direction," and Noah Webster sheds the light of his understanding upon the subject to the effect that "genius is an inborn bent of mind or disposition." From these nebulous and unsatisfactory explanations how gladly we turn to the latest number of the *Alienist and Neurologist*—a publication conducted in St. Louis by our esteemed friend Dr. Charles H. Hughes—and find a definition so clear and simple that the wonder is the world has gone so long without it. The gentleman to whom we are indebted for this great philological boon is an Italian, who responds to the calls of his patients under the name of Dr. Cesare Lombroso. He enters right into his subject at a single bound—*in medias res*, so to speak—and, without any preliminary flourishes, tells in the first line of his article that genius is "a degenerative epileptoid psychosis." Nothing could be plainer than that.

Starting out with this lucid definition, the learned Doctor proceeds to diagnose the cases of several of the world's most eminent men who have hitherto been suspected of genius. On the first page the poet Tasso is declared to have been "a periodical lunatic," and Jean Jacques Rousseau "a hebephreniac, whose misoneism originated in a desire for notoriety combined with suspicional delusions." And so on through a long list of great writers, including Pascal, Swift, Baudelaire, Poe, Haller and Walt Whitman. They are all more or less the victims of "degenerative epileptoid psychosis." This is what ailed some of them:

Many geniuses are addicted to alcoholic and narcotic abuse. Haller dosed himself with opium. Rousseau swilled coffee. Tasso was a notorious drunkard, as were Kleist, Gerard de Nerval, Musset, Murget, Mailath, Praga, Lorani, and the Chinese poet, Li-To-Kai, who was killed by excess in alcohol whence he drew his inspiration. Lenau latterly abused wine, tobacco and coffee, and Baudelaire, tobacco, wine and opium. Cardan was an inebriate. Swift was a patron of taverns. Poe, Southey and Hoffmann were dipsomaniacs.

Even Sir Isaac Newton is included in the list of those afflicted with "degenerative epileptoid psychosis," commonly known as genius:

Newton, who weighed worlds in the balance of his calculus was certainly insane when he attempted to interpret the "Apocalypse," or the horns of Daniel; and he was still more so when he wrote to Bentley;

"By the law of attraction the elongated orbit of comets is explained, but God alone can explain the lateral difference of the almost circular planetary orbit."

A very singular argument, as has been said by Arago, which places God at the limits where science has not penetrated. This very Newton, in his "Optics," declaims against those who, in the "Artistotelian" fashion, put occult qualities in things, thus limiting the researches of science, and a century later Laplace found the cause undiscoverable by Newton's calculus.

After all, had not the poet Dryden "degenerative epileptoid psychosis" in his mind's eye when he wrote:

"Great wits to madness sure are near allied,
And thin partitions do their bounds divide."

CLIMATE AND CRIME.

A Curious Connection.

Climatology is a fruitful study. It is vitally related to agriculture, sanitary science, engineering, mechanical arts; also to psychology, physiology and medicine. It is an old study. For example it has been shown how climate has changed not only complexion but cranial development. Austere conditions furnish a ruder, baser type, while a more genial clime produces a finer grade of skulls, with brains to match, inasmuch as social and intellectual development depends on the exemption from the exacting demands of either extreme of climate. Uniformity of climate tends to create homogenity of national character.

What temperament is to a man—that is, the angle at which he looks at things—climate may be said to be to a country. In one sense temperament is one's fate and climate is a country's fate. The slant of solar rays, varying from the vertical in equatorial regions to the angle which makes Arctic frost at the poles, imposes a destiny on the races of men. The best way to realise this is by taking a journey of 30,000 miles to and from India by the way of China and Japan. The immobility and social petrifaction, the torpid and tepid life of the average Asiatic is, in part, the product of physical factors. Inebriety is not common there as with us. As Canon Farrar says, we found India sober and made it drunken; we have belted the globe with drunkeness, sending from English and American ports cargoes of that which has cursed our own lands, to ruin the tribes of Africa and Asia.

The United States has been called "The Intemperate Belt." There is the birthplace of the disease inebriety, as distinct from the habit of drunkenness. There this malady has developed sooner and more rapidly than elsewhere. There it was first studied, and inebriate asylums were first established. It was in the United States that total abstinence societies started, for it was seen that no half way treatment availed. No moderate use of liquors is wise where climatic influences have so intensified the feverish rush of life to which racial, social and political factors contribute. First, notice the extremes of thermal changes in the American climate as related to this hightened nerve sensibility; and, second, the influence of the peculiarly dry, electric quality of the atmosphere upon the nervous system of the people.

1. The great extreme in thermal changes in New England, U.S.A., show a range of 125°, from 25° below zero to 100° above, in the shade. The year's record at Minnesota reads from 39° below to 99° above, a range of 138°. Even within twenty-four hours, and in balmy regions like Florida, the glass has leaped from torrid heat to frosty chill.

No wonder, then, that the greatest fear of some is the atmosphere. They dread to face alike the Arctic rigor or tropic fire, and get in the habit of staying indoors even in the exquisite weather of June and October. Rooms are made small, with double windows and list on the doors. In winter a roaring fire is in the cellar; another in the grate. The difference between this hot, dry, devitalised air within and the wintery air without is sometimes 80°, on an average 60°, while the difference of temperature inside and outside an English house is 20°. The relation of this to the nervousness of people is apparent.

2. The uniform brightness of American skies favours evaporation. The Yankee is not plump and ruddy like his moist, solid British brother, but lean, angular, wiry, with a dry, electrical skin. He lights the gas with his fingers and foretells the coming storm by his neuralgic bones. Hourly observations were made for five years with Capt. Catlin, of the United States army, a sufferer from traumatic neuralgia. The relation of these prognostic pains to barometric depression and to the earth's mangetism was certified beyond doubt. Even animals in certain countries are unusually irritable while the north desert winds are blowing and while electricity, seeking equilibrium, is going to and from the earth. Fruits, foliage and grass toward the wind shrivel. In other parts jets of lightning appear on the rocks and sometimes on one's walking stick. The heart beats faster in New York than in London, and faster still in the Western altitudes. "I can do more here," said Mr. Newman Hall, "I feel it to my finger's end." Climate helps to put a tremendous strain on heart and brain. Dr. Talmage truly says; "We are born in a hurry, live in a hurry, die in a hurry, and are driven to Greenwood, (Anglice: the cemetery) on a trot!" The perpetual play of this accelerated nervous energy is exhausting. As a result, a neurotic tendency is created, and men and women on the verge of physical bankruptcy cannot afford to add the stimulus of intoxicants.

HOW FLIES CARRY CONTAGION.

There can be little doubt that infections of various kinds may be more or less readily conveyed by flies. Wherever they alight they must bring with them traces of the objectionable matter they may have been assisting to remove. The window open for fresh air may admit flies which have come straight from some fever-stricken dwelling. Anyone who has been in Egypt will have an object lesson on the propagation of disease by flies. The many victims of ophthalmia to be seen there usually have their open sores covered by swarms of flies, which makes the presence and obtrusiveness everywhere in that country of this insect pest doubly abhorrent, from the possibilities of contagion by contact with them. The prevalence of ophthalmia in Egypt is attributed specially to these swarms of flies, which convey infection from affected subjects to those unaffected. In our own country there is no specific malady which may be thus mainly attributable to the germ-carrying action of flies, but it is quite possible that many cases, where the sources of affection cannot be traced, may have had their origin in the presence of flies unwittingly admitted from tainted places. It is said that the late Father Damien attributed the leprosy which brought about his death to inoculation by flies which flew from leprous patients to a wound on his head. It must be remembered that though cases doubtless occur in which infectious diseases are conveyed by flies, these insects do an immense amount of useful service by the scavengering which they so assiduously perform.

THE BREATHING OF A LOCOMOTIVE.

The "breathing" of a locomotive—that is to say, the number of puffs given by a railway engine during its journey—depends upon the circumference of its driving wheels and their speed. No matter what the rate of speed may be, for every one round of the driving wheels a locomotive will give four puffs—two out of each cylinder, the cylinders being double. The sizes of driving wheels vary, some being 18, 19, 20, and even 22 feet in circumference, although they are generally made of about 20 feet. The express speed varies from 54 to 58 miles an hour. Taking the average circumference of the driving wheel to be 20 feet, and the speed per hour 50 miles, a locomotive will give, going at express speed, 880 puffs per minute, or 52,800 puffs per hour, the wheel revolving 13,200 times in 60 minutes, giving 1,056 puffs per mile.

HOW TO OBTAIN KNOWLEDGE.

Lord Chesterfield was the author of the saying: "The knowledge of the world is only to be acquired in the world and not in a closet." It is in one sense a commonplace remark which everybody accepts as true, and yet, for nearly 150 years after it was made, nearly everybody has disregarded the deductions to be drawn from it. To this day its real lesson is disregarded in many schools of learning which, instead of preparing pupils to acquire knowledge in the field they may have chosen, profess to give it to them in a closet. Laboratory instruction, which has been greatly developed of late, corrects this faults in one respect by proving at least, a miniature world in which some knowledge of the real world may be obtained or the pupil started on the right road to future more extended studies. Men who have been educated in the closet or by books usually come to distinction, if at all, mainly through their studies elsewhere, but this fact is usually obscured by the habit of looking at schools as the only places where learning is to be obtained. It is true that schools have a very great value; they save the students years of toil and painful effort, they are not essential to his learning or advancement, as may be seen by the history of men who have attained distinction for their learning, though it is said of them that "their early education was neglected." That implies that they had a later education, but not in schools. Their "knowledge of the world," whatever form it may have taken, was obtained "in the world" by contact with and study of men and things. The man who has been educated by books is not thereby incapacitated from continuing his studies like the uneducated man from nature; he is, in fact, better equipped for such studies, provided he does not leave college with the idea that the diploma he carries is an all-sufficient token of his learning, absolving him from the duty of continued study. The true light in which to regard a diploma is that it marks the end of a preliminary course of study and certifies the fitness of the holder to enter the higher school, where he will be obliged to study men and things by actual contact and by original investigation. Educational reform moves slowly, but it has advanced far enough already to make this at least a tolerable idea. Authority, useful as a guide, is no longer accepted as final and unquestionable. Books are regarded as helps to knowledge, but not as knowledge itself. The laboratory system of teaching is one of the results of this changed view of the methods and purposes of education. Books are made the guides of the school room, but along with the study of books goes the study of the subjects of which they treat—not merely in the chemical or physical laboratory, but in the workshops, the engine rooms, the mine or the field. Practical experience with things supplements the study of what other men have observed respecting them. The student in such a school follows the methods of the patient investigators who are known as self-educated, only a few of whom have the courage and endurance required to carry them to distinction through such a painful course, but he follows these methods, guided by the instruction he has obtained in the closet, and his labours are thereby lightened. It is true that knowledge of the world is only to be acquired in the world, but it is also true that one may enter the world to begin the study more or less well equipped for the effort. It is the object of true educational systems to prepare and smooth the way, not to do away with the necessity for continued study after the school doors have closed upon the pupil. Experience is a great teacher, an essential but not the only teacher. One may learn from books or from the advice of others how to obtain the lessons of experience at the least cost, but the experience must be obtained if the lessons of the closet are to be of permanent value. The student who recognizes this as a general fact will be better equipped for any field of work that he may desire to enter than his companion, who believes that he has acquired "knowledge of the world" when he has committed his text books to memory, and has obtained certificates from his teachers that he has the accomplishments of a parrot developed to a high degree.

ADVICE.

So you were a little too pert, and spoke without thinking, did you, my son? And you got picked up quite suddenly on your statement, eh? Oh, well, that's all right; that happens to older men than you every day. I have noticed that you have a very positive way of filing a decision where other men state an opinion, and you frequently make a positive assertion where older men merely express a belief. But never mind: you are young. You will know less as you grow older. "Don't I mean you will know more?" Heaven forbid, my boy. No, indeed; I mean that you will know less. You will never know more than you do—never. If you live to be 10,000 years old, you will never again know as much as you do now. No hoary-headed sage, whose long and studious years were spent in reading men and books ever knew as much as a boy of your age. A girl of fifteen knows about as much, but then she gets over it sooner and more easily. "Does it cause a pang, then, to get rid of early knowledge?" Ah, my boy, it does. Pulling eye teeth and molars will seem like pleasant recreation alongside of shredding off great solid slabs and layers of wisdom and knowledge that now press upon you like geological strata. "But how are you to get rid of all this superincumbent wisdom?" Oh, easily enough, my boy; just keep on airing it; that's the best way. It won't stand constant use, and it disintegrates rapidly on exposure to air.

SIFTINGS OF THE STUDY.

"Other Suns than Ours."

(*London: W. H. Allen & Co.*)

This is perhaps one of the most interesting and comprehensive of all the late Mr. Richard Proctor's works. It teems with interesting chapters on life and science, and is written in that readable style which we so strongly advocate in our own columns. The chapters on "Parents and Children" and "Living Death Germs" are among the most interesting.

"Geodesy."

(*London: William Heineman.*)

Geodesy is a somewhat difficult subject to treat in a popular style, but it must be confessed that Mr. J. Howard Gore has mastered the problem in a very satisfactory fashion. He introduces his subject with the observation that "A knowledge of the practical sciences has now become a necessity to every educated man," an opinion with which we heartily coincide. The book will prove of interest to all those who care to know anything about the sphere on which we live, and the remarkable theories that have been advanced from time to time, to account for its condition and existence.

THE CHEMISTRY OF THE OCEAN.

THE study of 685 densities of the water of the sea made during the expedition of the Challenger, and the report of 108 series, of which each extended from the bottom of the ocean to the surface, the discussion of the results of the deep soundings obtained by Pola in 1890, the various theories relative to the chalk formations by chemical action, with the necessary intervention of living creatures, and, finally, the different observations of oceanic analysis with which M. J. Thoulet has been occupied for several years past, relative to the existence at the bottom of the ocean of two belts of water, one in repose, and the other in motion, are all in accordance with the following hypothesis:—

The surface of the ocean, submitted to climacteric changes, is in a state of heating and evaporation more or less intense. The variations which result in the real density and in the chemical composition of the waters, joined to the mechanical action exercised by the wind, give in the place of horizontal marine currents those more or less vertical, which cross between these where they overlie each other, with extreme quickness and in different directions. These together constitute oceanic circulation, which is effected almost entirely in a very shallow belt, about 500 fathoms in depth. The substances, only slightly soluble, contained in the waters of the seas, and brought to the ocean by the fresh waters which are far more dissolvent, attain at a certain depth their limit of solubility and form precipitates. Becoming solid, they descend vertically, penetrate into the still belt, and at last reach the soil at the bottom. Surrounded by immovable water, they dissolve and increase the proportion of salt contained in the deepest stratum of the water, and that immediately in contact with the soil. They then spread, and with extreme slowness, increase the saline quality of the adjacent waters, and at the same time extend to the stratum next to the soil which is not saturated, and consequently continues to dissolve the new material which arrives without cessation. The submarine soil is then a kind of centre of chemical activity, fed by fresh material from the surface, and radiating slowly toward the surface.

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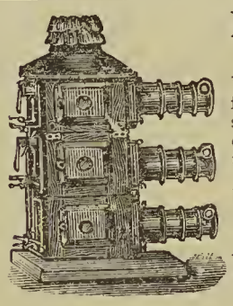

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SCIENCE NEWS & NOTES.

To Our Correspondents.

WE regret we are unable to reply individually to the many hundred letters we have received congratulating us on our success, and containing suggestions for the improvement of the paper. We heartily thank our correspondents for their good wishes, and they may rest assured that, wherever it is practicable, their ideas will be adopted.

Talking through a Person's Body

has been accomplished by an electrician, who joined the ends of cut wire long enough for a person to ring up and afterwards held an end in each hand but far apart, and two persons could talk just as well through his body as if the line had been connected.

The Science of Palmistry

has very rightly aroused the wrath of the *Referee*. A prediction of Boulanger's fate, elaborately compiled by a well-known professor of the art some years ago, has proved so utterly inaccurate and unreliable that our contemporary deems it quite time such arrant nonsense was discarded by all intelligent people, and in the present day the drawing-room unfortunately abounds with these "cranks," who might otherwise be considered fairly level-headed.

Lines and Formation of the Hand

are the indications by which character is delineated or fate foretold by means of this questionable science. The thumb is supposed to portray will and intellectual power, the first finger to show the higher ambitions, the second the darker passions, the third the artistic temperament, and the fourth the business qualifications. The base of the thumb is called the Mount of Venus, the base of the first finger the Mount of Jupiter, the Mount of Saturn is at the base of the second finger, that of Apollo at the third, and that of Mercury at the fourth. The elevation at the base of the hand and next the wrist is the Mount of the Moon, and midway between that and the Mount of Mercury is the Mountain of Mars. The palm is divided by lines, which are also fancifully designated. That round the base of the thumb is the life line; that which crosses the hand from the base of the thumb to the Mountain of Mars is the intellect line; that which runs from the base of the first finger to the Mount of Mercury is the impulse or heart line. Indications are drawn from the mounts according to their prominence and position, and from the lines according to their clearness, length, and freedom from splits or breaks. The entire science, if it be worthy the name, is in the highest degree fanciful, and has its foundation rather in idealism than in fact.

Mathematics and the Messiah

would not appear at first sight to have any connection, but the announcement, more or less startling, according to the acceptance it receives, was recently made that Professor Totten, of the Sheffield Scientific School of Yale, has perfected a mathematical calculation, founded on Biblical truths, which, he says, proves beyond question that the Messiah will reappear on the earth in the year 1899. This is the ingenious scholar who some time ago fixed the exact date when Joshua commanded the sun to stand still. He has also made curious calculations to show that the fundamental dimensions of the Great Pyramid are founded on distances in the solar system, and employed the inch unit of measure known to our English system of long measure. He has further made studies to show that Americans are the lost tribes of Israel. Professor Totten is a fine mathematician, but his prophetic departure is most embarrassing to the Yale authorities, who do not indorse his utterance in that field.

Faber's Talking Machine,

which was exhibited in Europe many years ago, was a most complex piece of mechanism, imitating as nearly as possible the organs of the human voice. It had a complicated keyboard, capable of various adjustments, and a bellows representing the lungs. As might be expected, the speech produced by this machine was very imperfect, and but faintly resembled the human voice. It is now of interest only as a mechanical curiosity.

The Pineal Gland

furnishes a remarkable illustration of the mysteries of the human form. It is almost in the centre of the lower part of the brain, and between the hemispheres of that organ. A fibrous body, in its lower portion there is a cavity filled with a sandy substance composed principally of phosphate and carbonate of lime. Its use is unknown, and absolute ignorance of the knowledge of its functions has inspired more than one fanciful theory as to what possible service it may be in the economy of the human frame, one ancient philosopher strenuously upholding the theory that it is the seat of the soul. The pineal gland, however, is not the only organ of the human frame of whose use anatomists are ignorant.

The Spleen

furnishes another illustration. It is a large vascular gland below the diaphragm, 4 or 5 inches long, and an inch and a half in thickness. Of about 6 ounces in weight, it is soft and spongy, well provided with blood vessels and nerves, but so far as is known it does not supply any secretion, and is therefore supposed to effect some necessary change in the blood. Its removal is not immediately fatal, a singular fact when taken in connection with the size and situation of the body. The ancients deemed it the seat of the temper, hence the common expression, "splenetic."

A Strange Phenomenon

has been observed by book-keepers, typewriters, and others similarly employed. It undoubtedly arises from what is commonly termed "brain fag," and consists in a strange tendency, at the finish of a hard day's work, to transpose certain letters as they flow from the pen or pencil. Those who suffer from this strange phenomenon find it difficult of explanation. It is done mechanically, and the transpositions slip from the pen. Thus, suppose one of these overworked mortals is writing 'James Brown was found dead to-day.' The sentence will slip along alright until suddenly he dashes down "to-day," and it slides from the pen "to-dya," or may be "found" is transferred into "foudn." Or again, in writing 365, it will slide off the pen 356. Or 281 becomes 218. It is noteworthy that the thinking powers when jaded cannot be concentrated, and are, therefore, no longer subservient to the will. This is a physiological fact that we have all observed.

The Speed of a Horse

is one of the marvels of creation. The record, we believe, is 1′ 35⅕″. There are few who have, through comparison and analysis, sought to realise what a terrible burst of speed this is. It is nearly forty miles an hour—a rate averaged by very few of our fastest railway trains. There are 5,280 feet in a mile, so that for every one of these ninety-five seconds—for every beat of a man's pulse—this wonderful "record" horse covered fifty-five and three-tenths feet of ground. The shortest space of time noted by the turfman's watch is a quarter of a second—an interval so brief that the eye can hardly observe, the mind can hardly appreciate it. Yet in every one of those 382 quarters of a second that magnificent creature leaped sixteen and three-tenths feet.

A Royal Mummy,

taken from the Egyptian catacombs, some time since, was found to be fitted out with an upper set of artificial teeth. The plate was of wood, carved to fit the roof of the mouth, and the teeth were of brass, the natural shape of the tooth being quite closely imitated. It shows that some one of the Pharaohs felt the loss of his incisors and grinders and had the court tooth doctor to do the best that could be done for him. Before this discovery it was commonly supposed that artificial teeth were a modern contrivance, but false teeth in ancient Egypt furnish convincing proof that there is nothing new under the sun.

Photographs of the Moon.

taken at full, give that body an egg-shaped appearance, with the small end pointing toward the earth. A recent writer argues that this goes to prove that planet's non-globular shape, as was indeed to be expected. According to this writer's reasoning, matter at the surface of the moon is acted upon by two important forces—the law of gravity would arrange the matter in a globe around the centre, the moon alone considered, and the attraction of the earth, being always exerted in the same direction relative to the moon's centre, would constantly draw all fluid or plastic matter to the side next the earth; the sun shines not less than 325 hours consequently on any given point on the moon's surface, and it is not probable that water on the surface would remain frozen under such continued sunshine, so that doubtless the fluid part of the moon's surface, obeying the constantly acting force that generates the tides on the earth, have long since gathered themselves together on that side of the moon nearest the earth. This idea, it is claimed, is not inconsistent with anything developed by the shadow of the moon in eclipses, nor with any known fact.

The Soul

has not escaped the attention of French scientists, and one of these gentlemen makes the astounding assertion that he has invented an instrument with which he claims the soul can be seen passing from the human body at the moment of dissolution. In his description, the soul, a short time before death, gradually appears, assuming the shape and appearance of the dying person, but in an exceedingly vaporous state. The figure is also described as being divinely perfect and beautiful, and a violet flame shines where the heart should be. The form floats about in the air about a foot above the body, to which it is attached by a delicate cord, but at the instant of death the cord breaks, the soul bids the body adieu with a sorrowful look on the spiritual face, and then, condensing into a small sphere, disappears. We think this sanguine inventor must be a near connection of Baron Munchausen.

Laughter

may be indulged in with little effort in Arabia, where a shrub known as the "laughing plant" grows. It is so called by reason of the effect produced upon those who eat its seeds. The plant is of moderate size, with bright yellow flowers, and soft, velvety seed-pods, each of which contains two or three seeds resembling black beans. The natives of the district where the plant grows, dry these seeds and reduce them to powder. A dose of this powder has similar effects to those arising from the inhalation of laughing-gas. It causes the most sober person to dance, shout and laugh with the boisterous excitement of a madman, and to rush about cutting the most ridiculous capers for about an hour. At the expiration of this time exhaustion sets in, and the excited person falls asleep, to awake after several hours with no recollection of his antics.

Telegraphing Without Wires

has recently been demonstrated by the success of several

experiments. Not long ago Mr. Preece, the head electrician of the Post-office telegraph department, succeeded in establishing communication across the Solent to the Isle of Wight, and telegraphed also across the river Severn without wires, merely using earth plates at a sufficient distance apart. It is now proposed to make practical use of this system in communicating with lightships.

Meteorologists

have led us so much astray of late—although it must be admitted that their errors have been due rather to the inadequate means at their disposal, than to scientific ignorance—that a hint on foretelling the weather for oneself is not out of place. According to a Spanish journal, which devotes itself to such subjects, a cup of pure coffee, with the addition of a lump of sugar, forms an excellent barometer. The sugar, according to our authority, should be put into the coffee without stirring, and, a moment afterwards, a quantity of bubbles, due to the air contained in the sugar, will be seen to rise to the surface of the liquid. If the bubbles collect in the middle of the cup, the weather will be fair; if, on the contrary, they leave the centre and adhere to the sides of the cup, forming a ring of bubbles, with a clear space in the middle, there will be rain; if they scatter themselves indifferently on the surface, the weather will be variable, while a cluster of bubbles on one side of the cup indicates rain. No one, apparently, has attempted to explain the connection between the behaviour of the bubbles and the atmospheric conditions, but it is said that the indications of the coffee-cup barometer generally agree with those of a mercurial barometer placed near by.

Volts and Amperes

are to be found in the every-day jargon of the electrician, but to outsiders the terms are a little difficult of comprehension, not to say confusing. By using the analogy of a waterfall, the meaning of these terms may be made clear. Say we have a current of water and a turbine wheel. If we have a turbine wheel and allow 1,000 gallons per second to fall from a height of 1 foot on the turbine, we get a certain power—we will say one horse-power. Now, the 1 foot of fall will represent one volt of pressure in electricity, and the 1,000 gallons will represent the ampere or the amount of current; we will call that one ampere. Thus we have 1,000 gallons of water or one ampere, falling one foot or one volt or under one volt of pressure, and the water working the turbine gives one horse-power. If now we go 1,000 feet high, and take 1 gallon of water and let it fall on the turbine wall, we will get the same power as we had before, namely, one horse-power. We have got a thousand times less current or less water, and we will have a thousandth of an ampere in place of one ampere, and we will have 1,000 volts in place of one volt, and we will have a fall of water 1,000 feet as against one foot. Now the fall of the water or the height from which it falls is the pressure or volts in electricity, and the amount of water is the amperes. It will be seen that 1,000 gallons a minute falling on a man from a height of only 1 foot would be no danger to the man, and that if we took one gallon and took it up 1,000 feet and let it fall down it would crush him. So it is not the quantity or current of water that does the damage, but it is the velocity or the pressure that produces the effect.

Rapidity

is the most interesting feature in the future of telegraphy. Some recent experiments show an almost incredible rate of speed. As many as 3,000 words per minute were transmitted by a roundabout line of copper wire 355 miles long between New York and Washington, while a speed of 800 was reached over the 1,000-mile line between New York and Chicago. The telegraph of the future will undoubtedly be largely conducted by means of such rapid transmitters as were used in these experiments. It may be interesting to note that the automatic machine telegraph employed in the experiments was of the perforated-paper class of instruments, registering each message by ink marks showing the ordinary Morse signals.

The Price of Telegrams

will, however, prove an important factor in the development of telegraphy, and there is no reason why the present rates should not be materially reduced. It has been shown that 100 words can be transmitted over 1,000 miles for one shilling, and yet allow a fair margin of profit if these new transmitters be used. Such a statement may appear a little surprising at first sight, but it must be remembered that a pair of lines working at the highest speed mentioned is the equivalent of something like forty complete quadruplex systems, each requiring its own wire and worked by the ordinary key. The decrease in expense of line and maintenance accomplished by the substitution of the transmitters for the ordinary instruments would be something enormous, to say nothing of the far smaller numbers of operators and instruments required. The perforation, of course, is done by machines constructed on the principle of the typewriter.

The Mouth

as an electric battery will sound like an odd notion to most people, but the theory is freely advanced that infinitesimal currents of electricity are set up in the mouth between the saliva and many kinds of food, especially those containing a large proportion of carbon; for instance, toast. The same currents are, in all probability, produced when teeth fillings of different metals occur in the same person's mouth; furthermore, the acute relish which we experience when eating certain combinations of food is, possibly, due to the action of these currents of electricity upon the sense of taste.

Hydrophobia,

has never, as far as medical knowledge goes, been transmitted from man to man, and this gives rise to the doubt as to whether the saliva of human beings, suffering from the disease, possesses the same virulent properties as that of the dog similarly affected. In not more than five or six of the ten thousand patients treated at the Pasteur Institute, was the injury due to bites inflicted by human beings, and it is evident that statistics bearing on so small a number of cases are of no value one way or the other. It has, however, been proved experimentally that the saliva of human beings having succumbed to hydrophobia, produces the disease in animals by inoculation, although the incubation period is somewhat prolonged. It may, therefore, be taken as proved that the disease may be transmitted in this way from man to man. It is hardly possible as yet to affirm categorically the possibility of curing hydrophobia after the characteristic symptoms have made their appearance, but recent observations throw a doubt on the incurability of the disease even under these circumstances.

Railway Speed

in Mr. Edison's hands, according to the latest report from Menlo Park, is to show some wonderful development at the Chicago Exhibition. Of course, electricity will be brought to bear as the motive power. As far as steam is concerned, most railway men feel that the possibilities are nearly reached, and that much greater speed is not practicable. A maximum of ninety miles an hour, with a running speed of sixty to seventy, is all that can be hoped for under the very best conditions. The limitations are numerous, and are well known to all engineers. The maximum speed of which a locomotive is capable has not been materially increased in a number of years. The time has been shortened, principally by reducing gradients, straightening curves, filling up ravines, and replacing wooden structures by permanent ones of iron or stone; by the use of heavy rails, safer switches, improved methods of signalling, the interlocking switch and signal system, the abolition of level crossings; in fact, by improvements in detail and management which permit a higher speed on a more extended section of road because of greater safety and the greater degree of confidence inspired in the engine driver.

Dust Particles in the Air

have been the subject of elaborate researches by Mr. John Aitken. The lowest number of dust particles ever counted was at Lucerne, when 3,500 went to the cubic inch, and there are seven millions per cubic inch in the ordinary air of Glasgow, but immediately above a Bunsen burner an inch contains 489,000,000. In a dirty town, three millions of bacteria per annum are deposited by the rain upon every square inch, and a man breathes thirty-six germs a minute in a town, and seventy-two in a close bedroom. Every winter day 350 tons of the products of the combustion of sulphur from coal are thrown into the atmosphere of London, with the result that fogs become suffocating. But as sulphur is good from a sanitary point of view, this is not an unmitigated evil.

Thousands of Curious and Ingenious Theories

have been brought forth to account for the fact that the sun, although he has whirled his burning disc across the heavens for untold ages, continues to burn without being consumed or his bulk being lessened in the least. Some learned men affect to believe that the great orb is a monstrous ball of gas, but even a great ball of gas would be consumed in its utmost atom in the course of a few thousand years. Others pretend to believe that its fires are kept up by the remains of wrecked worlds which are constantly falling into its depths, but even this seems far from probable, not to say a purely absurd conclusion. In giving his opinion on the last contention, one of the most eminent astronomers of the day has figured that a mountain range, consisting of 176 cubic miles, falling into the sun, would only be sufficient to maintain the present heat for a single second; a mass equal to that of our earth would engender only enough of heat to last ninety-three years. If these conclusions are correct, and we have no means of proving them false, well may we ask the question: Of what wonderful, indestructible substance is the sun composed?

The Phonograph,

at the time of its invention, was naturally compared with the existing talking machine, and the wonderful simplicity of the former was strongly brought out by the contrast. The comparison was unfair, however, for Faber's machine was an attempt to originate speech, while the phonograph only reproduces speech, which is quite a different matter. The phonograph, and by that is meant the machine under its various forms and names, has, up to the present, served as a valuable apparatus for the analysis of sound, but it does not seem to have occurred to any one that in the synthesis or putting together of sounds, it is capable of producing supremely wonderful results.

The Vibratory Nature of Sound

is well known to students of physics, and it is a matter of common knowledge that the pitch of a musical note depends upon the number of vibrations per second which produce it; but it is not so well known what constitutes the difference between the tone of a violin and of a flute, both sounding a note of the same pitch, that is, having the same number of fundamental vibrations per second.

The Violin String

not only vibrates as a whole, producing its fundamental note, but also in its different parts, producing a number of very rapid vibrations which blend with the fundamental and impart its peculiar quality of timbre. The extra vibrations are called overtones or harmonies, and it is their presence in a different degree which distinguishes the sound of the flute from that of the violin, or which makes a voice loving, persuasive, and sympathetic, or hard, rasping, and disagreeable. Were it not for the harmonies, music would be insipid and unpleasant. A tuning-fork produces such a tone. It is quite free from harmonies and has pitch only, being noticeably devoid of quality. By means of a number of tuning forks, however, so vibrated as to produce the overtones in proper relation to the fundamental, almost any musical instrument may be imitated. This is the synthesis of sound. A phonographic record of a pure tone would be a sinusoidal curve, but a tone having quality would show the overtones indented upon the sinusoidal curve, producing the ragged lines seen in the pictures so commonly used to illustrate this point in works on acoustics.

The Phonograph or the Gramophone

in ordinary usage—the latter is better for this illustration, as its record is in the form of curves on a flat disc—make the record by the voice, but if by any other means the sound curves could be enlarged upon the disc, the machine would reproduce the sounds just as faithfully.

If all the Tuning-forks

in the world were, therefore, destroyed, never to be used again, Emile Berliner, by etching a sinusoidal curve upon his gramophone disc, could, in less than week, restore to the world its concert pitch. It would be quite within his powers to cause to be engraved upon the disc a series of curves, which would reproduce any simple tune as though it were played upon tuning-forks, that is, giving differences of pitch only. Having thus produced the skeleton tune, it would only require an extended series of observations of the timbre curves of the cornet, for example, to impart to the record the quality of that instrument.

The Human Voice

might be mechanically produced in this way, as if it were proved possible with the cornet, it could, of course, be done with any other instrument or combination of instruments. The characteristic curves of any given voice being determined, it would be possible to cause the machine to utter the lines of any speech or the melody of any song in the tones of that voice. If all of the musical instruments in

existence should be externally wiped out, and all men should suddenly be struck dumb, modern science, with the phonograph, could supply the world with music, and mankind with speech and song.

The Theoretical Possibility

of such a result is beyond dispute, yet the practical difficulties in the way of such a prodigious accomplishment are almost appalling. While the existence of all but insuperable obstacles must be admitted, it should be borne in mind that they are mainly mechanical, and that the resources of science are infinite. The first step towards any scientific attainment is to show its theoretical possibility. In this case this has now been done, and hundreds of plans of practical procedure are looming up to mind. Mere manual dexterity will not form a necessary part of the musical science of the future. A symphony will some day be expressed in mathematical formulæ, but science can never furnish the soul for music or invade the domain of creative intellect.

The Deepest Well

in the world is being sunk by the United States Geological Survey, in order to gain information as to strata. The idea is to take the temperature and magnetic conditions as far as possible, and by means of an instrument constructed for the purpose, a complete record of the progress, and all discoveries made will be kept and placed in the Geological Survey exhibit at the World's Fair. It is, however, questionable whether the game is worth the candle, since it is foredoomed to failure, as it is sheer folly to talk about sinking a well three, four, or five miles deep. There has never been the rope or cable made that would support its own weight if hung in a perpendicular manner for this depth as must be done in boring an artesian well. Should a cable of sufficient strength be constructed, it would be necessary to construct a more powerful engine than has yet been built. It is easy to talk about boring through to China, but when you reach 1,000 feet, the work becomes a little too expensive and difficult to carry any further.

The Laws of Gravity

are well known to us, but of the thing itself we know nothing. It may yet be proved that gravity is also an action propagated through the ether. It would thus come under the domain of electricity, which seems destined to absorb all of the sciences. Perhaps, then, when the great secrets of nature are unlocked, we may be able to suspend or screen its action at will. This would be a most stupendous triumph of electricity. Until the scoffer can tell what gravity is, let him not ask, "What is electricity?"

Many actions

which are now ascribed to gravity were formerly accounted for in a manner which seemed quite as reasonable as our present explanations. The ordinary suction pump, it is now known, depends for its action upon the pressure exerted on a column of water by the air; but in the time of Aristotle it was explained by saying, "Nature abhors a vacuum." It was observed that space always seemed filled by matter, and the moment a solid body was removed its place would be filled by air or water. Thus, when the piston of a common pump was lifted, the water was caused to rise, and the explanation was all sufficient. It was not until the seventeenth century that the defect in this theory became apparent. The Duke of Tuscany sank a very deep well, and notwithstanding the skill of his best engineers, the water would not rise in the pump much over 20 feet. Galileo, who was then near the close of his career, was appealed to, but he, after remarking that nature did not abhor a vacuum above 10 metres, referred the matter to his ablest pupil, Torricelli. The latter reasoned that if it was the weight of the air that sustained the water, it ought to sustain a much shorter column of a heavier liquid like mercury. He accordingly inverted a long tube filled with mercury over a pan of that liquid, and found that the mercury fell until it came to rest at a height a little over 30 inches, leaving a vacuum at the top of the tube. This upset the Aristotleian doctrine that nature abhors a vacuum, and prepared the way for the law of gravitation.

Unbreakable Glass

is a problem that has puzzled our glass manufacturers from time immemorial, and a satisfactory solution of the difficulty is as distant as ever. Tacitus tells a story of a glassmaker who manufactured glass of such a degree of flexibility, that on dashing a vase made of it on a marble floor, the vessel was only bent as one of metal might be, and with a hammer he restored it to its original form. As he pretended that the invention was the result of the discovery of the philosopher's stone, he was put to death by the Emperor Tiberius, in whose presence the vase was exhibited. Flexible glass is said to have been twice rediscovered since that time, once by an Italian, once by a Frenchman, but in neither case was the invention given to the world, and no articles of malleable glass are known to exist. By several processes of annealing glass may be rendered quite tough, so as to stand much rougher usage than the unannealed variety; but aside from the story told by Tacitus, which is in itself somewhat doubtful, there is no reason to suppose that glass was ever rendered malleable. When spun into threads it has been used to a limited extent for textile fabrics, but only as a curiosity.

A Cosmical Telephone,

by means of which the inventor hopes to hear sounds resulting from solar causes, is said to be a forthcoming marvel. It may be said, however, that it is pretty well established that sound cannot travel without a medium, either solid, liquid, or gaseous. So far as is known there is no medium between the earth and the sun beyond the limits of the terrestrial shallow atmosphere capable of transmitting sound waves, and until it is shown that such medium exists, the theory of inter-solar transmission of sound will not find ready acceptance among physicists. The strange sounds heard by Mr. Edison, as he states, while experimenting with the long-distance telephone, if cosmical at all, were, it would seem, much more likely to have been of seismic (earthquake) origin. Furthermore, judging by present knowledge as to the rate of the sound transmission, there was no connection between the sounds heard and the observed sun spots, for if Mr. Edison, as he suspects, really heard sounds from the sun, the cause that produced them must have taken place more than thirteen years before they reached the earth, unless it be proved that sound may be transmitted by radiant electricity or some other equally rapid agent. That Mr. Edison's experiments may result in important discovery is much to be hoped, but at present it seems hardly probable that he will ever be able to hear the roar and crash of solar tempests.

What's in a Ton of Coal?

has been satisfactorily answered by Prof. Rogers, of Washington. According to the professor, a single pound of

good steam coal has within it dynamic power equivalent to the work of one man for one day. Three tons of the same coal represent a man's labour for the period of twenty years, and one square mile of a seam of coal, having a depth of four feet only, represents as much work as one million men can perform in twenty years. Such calculations as the above serve to remind us how very wasteful our methods of burning fuel are, in spite of the efforts of inventors in the direction of economy.

Gold is used

so largely by dentists, in preference to silver, although the latter metal would resist the acids found in the month quite as well, not because the dentist desires to run up a bill, but because gold is the only metal that will weld while cold. Silver will not do so, nor will anything else. The cohesive properties of perfectly smooth and clear gold are astonishing. If you take a sheet of gold foil and let it fall upon another, both will be so firmly joined that it will be impossible to separate them. It is this property that makes gold valuable to dentists, and not the desire to increase bills.

A Painted Sham

is what a correspondent, who complains of our leaning towards "Modern Theoretical Astronomy," terms that science. The nigger in the fence, in this case, exists because we choose to accept the well-proved theory that the world is spherical, or rather an oblate, or flattened spheroid, instead of, as our correspondent appears to think, plane. Our correspondent forwards a book entitled "One Hundred Proofs that the Earth is not a Globe." We have read pretty nearly all these hundred "proofs," with the result that we are "of the same opinion still." The hundred proofs rely for substantiation chiefly on the statement that the seas are plane and not spherical. Now, this might easily be the case, without upsetting our belief that we live on a globe. Since water finds its own level, it is compatible with the theory of a spherical or oblate world, that the sea is a plane of water covering the cavity formed by Nature for its reception. If we accept the theory of a plane world, how is it (the author of the work under notice rejects gravitation) the waters do not rush over the sides into space? how is it no one has ever been to the end of the world? or, if anyone has, are we to believe that the unfortunate discoverer tumbled over the edge of the plane and was heard of nevermore? "The other side of the question" is always interesting, and we have no hesitation in saying that the other side of the "One Hundred Proofs" could be supplied by the merest tyro in Geodesy.

SIFTINGS OF THE STUDY.

Handbook for Steam Users.

(London: Longmans, Green, & Co.)

This handbook for steam users comprises a variety of information for all those who in any way use steam power. Mr. M. Powis Bale, M.I.M.E., A.M.I C.E., from whose pen it comes, is evidently well up in his subject.

IDEAS & INVENTIONS.

Any of our readers possessing ideas, or inventions which they may consider worth patenting, may communicate, free of charge, with our Patent Editor, whose experience in this department, warrants us in believing that the advice given will be sound and practical.

GLEANINGS OF THE GLOBE.

Photography is now taught in all the higher schools of Japan.

Young snails come from the egg with a shell upon their backs.

Some insects are in a state of maturity thirty minutes after birth.

The deepest sea sounding ever made is 4,655 fathoms, or 23,275 feet, off the North-East coast of Japan.

The Chinese language is said to be best adapted to telephonic conversation, because it is monosyllabic.

All sounds, whether strong or weak, high or low, musical or discordant, travel with the same velocity.

An expert electrician asserts that an electric train, making 125 miles an hour, would require 7,000 feet in which to come to a standstill.

A pound of coal yields enough magenta to colour 500 yards of flannel: vermilion for 2,560 yards: aurine for 120 yards: and alizarine sufficient for 155 yards of Turkey red cloth.

Telescopic steel masts of rods are to be used in lighting the public squares in Brussels. The object of this system is to preserve the beauties of the park in the daytime.

There are earthworms in Gippsland, Australia, over two yards in length. Their scientific appellation is *Megascolides Australis*.

Prof. Tacchini, at Rome, has found that the marching of a regiment of soldiers 150 yards away was registered by the earthquake apparatus located in the tower of the college at a height of 125 feet above the city.

The pupil of the eye is merely an opening through which the rays of light pass into the inner chamber. There being, therefore, nothing in the pupil to reflect light, it always appears black.

From a recent computation, it is estimated that the unexplored regions of the North and South Poles extend to 350,725 sq. miles; that is more than double the area of the whole of Europe, or about one-sixteenth part of the whole world.

Magnifying glasses are of great antiquity. The dialogue between Strepsiadus and Socrates in the comedy of "The Clouds," shows us that the Greeks knew the use of these instruments at least 3,000 years ago.

Brandy will resuscitate some kinds of fish—especially the carp species—apparently after death from a long absence from their native element. A carp may be kept alive for over twelve hours by a piece of bread soaked in brandy and placed in its mouth.

The remains of about a hundred elephants have been found at Mont-Dall, in Brittany, where they are gathered on a surface of about nineteen hundred square metres. All the

bones are broken, and it is thought that the animals must have been eaten by prehistoric men.

The display of prismatic colours by a soap bubble is caused by the refraction of the light falling upon the film of soap. As the thickness of the film changes, the degree of refraction is altered, and thus the kaleidoscopic display of beautiful colours is produced.

Hiccough is caused by a spasmodic twitching of the diaphragm, a thin muscular membrane which divides the chest from the abdomen. It generally arises from sympathy with the stomach. The muscular twitches and jerks are so many efforts on the part of the diaphragm to assist the stomach to get rid of some undigested matter.

The British Dental Association recognises two great causes of deterioration in human teeth. One is the lavish waste due to having teeth pulled out on the slightest provocation; the other is starvation of the teeth by modern cookery, and the small use of fish and other food capable of keeping up the necessary supply of earthy salts. It is also stated that over-stimulation of the brain in children leads to undue withdrawal of phosphates from the circulation at the expense of the teeth, and that chronic dyspepsia is another cause of the failure of teeth.

An experiment has been made by Dr. Pringsheim, of Berlin, to determine the position of accent in French words by a physical method. A phonograph was used, into which a number of Frenchmen spoke, and the record was afterwards measured by means of a tuning-fork curve running parallel to it. It was possible thus to determine the duration, pitch, and intensity of each syllable. As the results related to French words only, it may merely be mentioned here that the shortest syllable, é, in été,, with rather a slow pronunciation, consisted of twenty-two vibrations: yet the ear, besides hearing the note, is capable of detecting fine shades and differences in the mode of pronunciation.

Anaximander, a philosopher, who lived six centuries before Christ, represented the earth as a cylinder, the upper face only being inhabited. He computed that its height was one third of its diameter, and that it floated freely in the centre of the celestial vault. When asked why this cylinder did not tip over, he replied that in the absence of a reason why it should tip in any one direction rather than in another, it did not tip at all, hence remaining in this state of helpless indecision. Mr. J. Howard Gore refers to this in his new book on "Geodesy," and we exclaim with him, truly a "sufficient reason!"

Electricity has been called to the aid of those ingenious rascals who engage in the operation known as "sweating" gold coins. The service of an ordinary battery and some cheap acid is all that is necessary to conduct the operation. The scheme is similar to that employed in plating with gold by electricity. The coin is placed in the fluid, and attached to it are wires from the poles of the battery leading to another piece of metal prepared to receive, in the form of plating, the metal to be removed from the coin. The battery being connected, sufficient gold to form a plating is quickly transferred, and, as it is used uniformly from all parts of the coin, the liability of disfigurement is reduced to a minimum. The only effect is to blur the characters slightly. About 1s. worth of gold can be removed in this way from a 20s. gold piece without exciting the suspicion of the casual observer.

IS FLYING FEASIBLE?

Inventors in every quarter of the globe are to-day, for some unexplained cause, turning their attention to the possibility of flying machines. The flying craze has become epidemic, and the two most notorious cases of infection are those of Mr. Maxim, in London, and the constructor of the Great Chicago air ship.

We do not pretend to adjudicate on the feasibility of flying, but it will not be uninteresting to review the qualifications theoretically essential to a perfect flying ship. It is assumed, in the first place, by one of those deeply infected with the epidemic to which we have referred, that it is necessary that the air should help to propel the air ship or car by opposing the propulsive force with a resistance sufficient to cause that force to react against that vehicle; and a resistance sufficient for this purpose is sufficient to support the vehicle. The flying bird exhibits the air under conditions pointing to great latent, inherent forces. This latent resistance is illustrated by the soaring vulture, supported by the air without using the propulsive force of its wings, and by the same bird carrying as freight or passenger a prey weighing more than itself.

One scientist claims to have discovered a latent resistance in the air sufficient to support and propel carriages carrying many hundreds of passengers and many hundred tons of freight. To this latent resistance he gives the name of anthexis. Probably, this is only another name for ether.

Anthexis he describes as the resistance of the air column formed through certain means and conditions, which, decreasing with the altitude, is at sea level over 2,100 pounds, and at a height of 20,900 feet over 1,100 pounds for every square foot of impinged air-column surface. This method of air conveyance embodies the use of anthexis, and its practical features, according to its exponent, are an air car, preferably built of steel or iron, in shape a cross between the water ship and the bird, provided with wings for ascent, descent and support in air, with propeller and rudder for onward propulsion and control of course, and with steam power for working those devices. The wings, propeller and rudder are alike, and peculiarly constituted—namely, with certain physical properties in addition to their mechanism, for it is through these properties that anthexis is obtained.

It is claimed that extreme speed, perfect safety and great saving of power will be insured by this contrivance, and that it will make transportation by air the final and perfect form of conveyance.

The air car will rest firmly, in proportion to its weight and load, upon two expansive air columns formed by the wings, and also against the air columns formed by the propeller and rudder, so secure that neither gravity nor storm, however violent, can displace it. Descent is also to be made through power, and here, as in ascent and upward locomotion, government of the air car and control of speed and course will be absolute and perfect. A normal speed of 300 miles an hour will be as practicable as thirty miles on the railway, with less expenditure of power for an equal load. A peculiar great saving in power afforded by anthexis will stand in good stead in ascent, rendering a very high speed practicable. This will be appreciated when it is understood that to lift but 100 tons at a speed of only six miles an hour into space requires more than 3,200 horse-power.

Fired with his triumph over the powers of the air, the enthusiast of flying rushes on his anthexis into the empyrean where his prophetic eye discerns the dissolution of the peace societies and the bankruptcy of Krupp.

The intelligence of our time, he maintains, is prepared and

looks for the new and better mode of conveyance, and long enough has the brute had the exclusive privilege of swift and safe travel. At least, we will take possession of this empyrean, which, from the beginning, was intended to be the one great highway of the inhabitants of the globe. It is not yet fifty years since the first message flashed over the first electric wire. "What God has wrought." A still greater boon is, we are told, about to be vouchsafed to humanity in the establishment of a mode of transportation that offers absolute safety, and with its enormous speed and saving in power, with its conditions of comfort, health and delight, is sure to greatly cheapen and increase travel. And when to these considerations is added a momentous moral factor, the abolition of war, which becomes inevitable with the establishment of air transit, the undertaking combines, as none other ever did, everything calculated to most effectively appeal to heart, head, purse and public spirit.

THE RUSSIAN FAMINE AND OTHERS.

The Russian famine now prevailing has drawn public attention to other terrible disasters of this kind. Famines were formerly much more common than during the last half century, and many notable calamities of this nature are mentioned by historians. Not including the seven years' famine in Egypt mentioned in the Old Testament, the first great famine noted in history was in Italy, B.C. 436. Thousands of persons, driven mad by want, threw themselves into the sea and rivers to escape from further suffering. In A.D. 42 there was a great famine in Egypt, and another in Rome and the vicinity in A.D. 262. In 272 famine prevailed over the British Islands, and people ate grass, roots and the bark of trees; thousands died in Scotland from privation in A.D. 306, and over 40,000 perished in Britain four years later. In A.D. 450 famine prevailed all over the south of Europe, raging worst in Italy, where parents ate their children, and in 739 England, Scotland and Wales were again ravaged, also in 823, when thousands starved, and in 954, when crops failed for four successive years. In 1016 an awful famine raged throughout all Europe, and again from 1193 to 1195, when crop failures caused terrible suffering. In England and France the people ate the flesh of dogs and cats, and many cases of cannibalism were recorded. There were famines in England in 1251, 1315, 1336, 1348 and 1565, and general distress prevailed also in both England and France in 1693, 1748, 1789 and 1795. The great Irish famines of 1814, 1816, 1822, 1831 and 1846 were in consequence of the failure of the potato crop, and no doubt in each thousands of persons starved to death. European calamities of this kind, however, dwindle into insignificance when compared with the colossal dimensions of a famine in the crowded countries in Asia. In 1837 over 800,000 human beings starved to death in North-west India, and in 1860 another famine carried off 500,000. In 1865, 1,000,000 people were supposed to have starved in Bengal and Orissa, and in 1868 the death-roll from famine in Rajpootana exceeded 1,500,000. Even as late as 1877 about 500,000 perished in Bombay, Madras and Mysore. The worst calamity of this kind ever recorded took place in the years 1877 and 1878, in China. Complete crop failure took place in all the northern provinces, and the number of those who perished from want of food was estimated at 9,500,000. As the internal communications of a country are improved the danger of wholesale starvation is much lessened. It is not likely that, save in Russia, Persia and China, there will again be such dreadful loss of life.

IF THE MOON FELL ON THE EARTH!

The days have barely passed away in which the student was taught to believe in what was termed the attraction of gravitation. He was told that the sun attracted the earth, the earth, the moon and stones and shot and men. He learned that every form of matter attracted every other; and he was told, further, that Newton was the first to discover this fact. In the same way it was explained that a magnet attracted a bit of iron, and so on. The force gravity and the force magnetism were attributed to some specific property inherent in matter and in the magnet. Recent text-books are sounder guides; we no longer hear that a magnet "attracts," and the phrase "attraction of gravitation" has become well-nigh obsolete. But the teachers of science have not yet gone far enough. They have, indeed, ceased to assert that the sun attracts the earth by a specific display of inherent energy, but they have not clearly explained that matter does not attract matter and that the force of gravitation is due to an extrinsic agency. The able address recently delivered by Dr. Huggins to the British Association still assumes that matter can attract matter, although it is quite probable that this was not the meaning the author intended his words to convey. As yet gravity has not been sufficiently considered as a form of energy which has nothing in common with the popular use of the word attraction, and we think the time has arrived when something may be said with advantage on the subject.

It is commonly stated that if the moon fell on to the earth, enormous heat would be generated by the collision. One of the favourite explanations of the permanence of the sun's heat was, says the *Engineer*, based on the theory that it was constantly bombarded by showers of meteors. We say "was" because the theory does not in the present day meet with acceptance. Instead, the view is advanced that the heat of the sun is maintained by shrinkage; that the gravitation of its parts towards the centre represents work which re-appears as heat. Whether this view is or is not sound we need not stop to inquire; we may assume that it is. But if it is, then it can easily be shown that gravity has nothing to do with attraction. The simplest method of putting this truth before our readers lies in considering what would happen if the earth or any other planet fell into the sun. An enormous amount of work must be done on the earth in continually accelerating it while it traversed the 93,000,000 of miles or thereabouts of space which intervenes between the planet and the star we term the sun. The energy stored up in the earth, its *vis viva*, would reappear in great part in the form of heat when the final collision took place. On the other hand, if the indrawing of the earth was due to that putting forth of energy implied by the idea, that the sun attracted the earth, it is clear that the sun would be cooled down while the earth was being drawn in. About as many heat units must be expended in doing work on the earth, as the earth could afterwards restore to the sun by collision. In a word, the energy of the system would remain unchanged in amount. We believe that Dr. Lodge some years ago called attention to this aspect of the action of gravitation. Of course, what holds true of the earth falling into the sun, also holds good of the falling in of any portion of its mass toward its centre of gravity, and for this reason shrinkage is due to the attractive effort of one portion of that mass on another portion. This is consistent with the law that the sum of the energies of a mass system cannot be altered in amount by the interactions of the component parts of the system. Whatever energy was in the sun and the earth before the latter began to fall into the sun would be in them after collision had taken place in the way supposed and no more.

If, now, we abandon once and for all the notion that matter can exert an attractive force on matter, and regard gravity as an external agent, the whole aspect of affairs undergoes change. The work done in impelling the earth into the sun would then be done not by the latter but by the extrinsic force which we term gravity; and this being so, a very considerable rise in temperature of a portion at least of the sun's mass would certainly take place. But this view at once leads us to regard gravity from a point of view which, as we have said, has scarcely yet been properly considered. It appears in a new aspect; we see that it is as much a force of nature as light. It is a form of energy which acts on matter, and is not a property of matter. Instead of being the active agent, matter is purely and absolutely passive under its influence. One great advantage which follows is that we are rid for ever of the notions involved in the words "potential energy" once commonly applied to a mass in such a position that by moving under the influence of gravity it can do work. For example, when a clock weight is wound up we have all been taught that the energy expended in the winding is stored in some mysterious way in the weight. The truth is that the energy has been expended on gravity, whatever that is, and is stored in it, not in the passive weight. The idea implied in the words "potential energy" is flatly opposed to the view that all energy is kinetic or motory; that, in fact, all forces of every kind are modes of motion. This theory has been deservedly rapidly growing in favour of late years, and is held by the soundest as well as the most advanced thinkers; but it is obviously opposed to the potential energy motion. If energy can be stored in a raised weight, itself at rest, it is clear that all energy cannot be kinetic, or active. This difficulty is at once cleared out of our path by a recognition of the truth that gravity itself a form of kinetic energy. The mystery of it remains as far from solution as ever; but the acceptance of a right belief concerning its nature will help the world to formulate a theory of it. To arrive at a knowledge of what a thing is, it is a great assistance to be certain of what it is not. It is universally conceded that if a planet fell into the sun, that the temperature of the sun would be raised; but it is as we have briefly tried to show, impossible that, this being true, it can also be true that the sun or any other matter can exert a force of attraction. When a boat is anchored in a stream, the pull on her cable is due to the river, not to any effort put forth by the boat.

A VERY important point to be observed, if tea is to serve as a wholesome, refreshing beverage, is the method of drinking it. It should never be taken with food in alternate swallows, according to a too prevalent custom. No liquid of this character should be taken with food. A horse or cow would die of indigestion if food and drink were administered to the animal as these are used by many people at their ordinary meals. First eat and then drink is the example set by the brute creation. A meal should always be served in courses, no matter how plain the table. We suggested to a poor man who had beefsteak, baked potatoes and asparagus, with a mug of chocolate, for dinner, to serve each dish separately. He replied that all went to one place in his stomach, and he could see no reason for this distinction. We asked why he did not put the asparagus into his drinking cup and pour the chocolate over his potato if it made no difference. He caught the idea; first opened, seasoned and ate his baked potato; then had his steak served to be eaten by itself; after this his asparagus, which is always spoiled if mixed with any other article of food; then he poured out and drank his chocolate, and declared he had not partaken of so good a meal for many a day.

PHRENOLOGY EXPLAINED.

By STACKPOOL E. O'DELL.

Author of "Phrenology: its Truthfulness and Usefulness," "Old St. Margaret's," "Merciful or Merciless?" "Brompton Lectures," "Mental Troubles," etc.

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III.

THE names of the phrenological faculties are, in the domestic group, amativeness, conjugality, philoprogenitiveness, friendship, inhabitiveness. The selfish propensities consist of vitativeness, destructiveness, acquisitiveness, secretiveness, cautiousness, approbativeness, self-esteem. Moral statements include conscientiousness, hope, marvellousness or spirituality, veneration, benevolence. The perfecting or semi-intellectual sentiments embrace constructiveness, ideality, sublimity, imitation. Perceptive faculties embrace individuality, form, size, weight, colour, order, calculation, locality. Faculties denominated literary, though not necessarily confined to literature, are eventuality, time, tune, language; while the reasoning faculties are causality and comparison. The following faculties, which we do not here place under the heading of any particular group, conclude the total of forty-two:—Concentrativeness, firmness, mirthfulness, human nature, and agreeableness. In connection with these faculties the phrenologist takes into account organic activity, mental, vital, and motive temperaments; likewise the general state of the health in its relation to the brain, and consequently mental manifestation. This includes breathing, circulatory and digestive powers, with the general nervous system. For a phrenologist to take a right and accurate measurement, so far as accuracy can be obtained, of the various powers of a man's mind, he has to take into consideration all that is here stated. He has to consider these items not alone individually, but in combination one with another; he makes due allowance, for it may be excesses in one part of the constitution and deficiencies in another. After summing up the whole, he is enabled to discern the degree of strength or weakness of mental action. The phrenologist may, through the medium of new discoveries, know more in the future, but up to the present it is better for him to limit himself to pointing out tendencies of character, though in many cases he may feel assured that it is not alone tendencies that are revealed to him, but positive certainties. This is the case when some portion of the mental indications are of a pronounced character, or, if he is acquainted with the education and environment of the individual, which will enable him to calculate upon the external inducements acting upon the faculties, exciting them to activity or inducing to dormancy. It must be acknowledged that it is but right to take into consideration the physical and mental constitution or capacities before undertaking any particular work, either of a physical or mental nature. We claim for phrenology that it is capable of gauging this strength, even to a degree, so that it can give good and useful advice to all men of all conditions before they embark upon any special work, such as a profession, trade, or any occupation in life. Phrenology commences with the child at its very earliest age, and tells the parent, upon proved scientific bases, its tendencies; for instance, to be excessively cautious through the faculty of cautiousness predominating. This cautiousness, if not restrained, will cause the child much misery through its constant fear, both real and imaginary. It will likewise prevent it from successfully competing with other children in the schoolroom. It will be afraid to answer even ordinary questions, because of expected censure or punishment in case

of error. Unless this faculty be checked in the child, which can be done, it will grow with the child's growth, and follow it through life, entailing constant fear and anxiety, and causing what is termed cowardice, better called excessive cautiousness. Or the phrenologist points out to the parent the excessive size of the faculty of alimentiveness, which will predispose the child to gluttony, and entail not alone selfishness in respect to the faculty, but physical pains and penalties. By the aid of phrenology the youth or young man can feel assured that he is at the occupation best suited to his capacity. It says to one, "Your mental and physical capacities will enable you to be successful at a profession," and to another, "at a trade." Work, whether mental or physical, or both, can thus be made pleasurable instead of irksome. Much unhappiness in life comes from inequalities in the forty-two mental faculties we have pointed out. Phrenology is capable of indicating these inequalities, and showing the best methods of harmonising them. Phrenology does not alone confine its attention to solitary individuals, but it studies races and nations, and is competent to show a race or a nation its own peculiar constitution, mentally and physically, and thereby indicate the best methods of government—government that will be in harmony with the constitution of man, so that both individuals and states can govern themselves on scientific principles.

SCIENTIFIC HORSE TRAINING.

SCIENCE is so rapidly invading every department of life, that we are not surprised to learn it is intended to turn it to some purpose in the direction of horse training. The value of a high stepping horse over one with inferior action is well-known and appreciated. Everybody admires the horse that carries itself well. The prices asked for high-stepping horses have set the scientific horse-trainer thinking, and, with the aid of the optician, he has been able to do much to improve the action of the animal. The contrivance takes the form of a specially-constructed pair of spectacles, the first of which has been designed and made by Messrs. Dollond, of Ludgate-hill. The frames are made of stiff leather, quite enclosing the eye of the horse, and the glasses employed are deep concave, and large in size. The effect produced is to give the ground in front of the horse the appearance of being raised: the animal, therefore, steps high, thinking he is going uphill, or has to step over an obstacle in front of him. If the system is persevered with when the animal is young, the effect is said to be marvellous.

Spectacles for horses are perhaps not entirely novel, but the idea will certainly commend itself to those who understand the peculiarities of the animals' full, large, prominent eyes. Many horses could be materially improved by a visit to the optician, and we think the sight of all horses should be tested. This particularly applies to valuable hunters, which are found optically unfit for their work, when a little artificial assistance would make them as useful as ever. Apart from this consideration, many vices might be cured by means of eye-glasses. For instance, as a rule short-sight is the cause of shying.

DR. MOTAIS, of Angers, finds that the hereditary tendency to short sight is of a cross nature; that is to say, a short-sighted mother would transmit her infirmity to her sons, while a short-sighted father's defect would fall upon the daughters.

WHAT IS A MICROBE?

Far down in the scale of plant life is a certain great group whose individuals are spoken of in a general way as micro-organisms, or microbes or germs. One great family of the group of micro-organisms is called "yeasts." The commercial value of the single yeast plant may be estimated from the fact that the cake of yeast costing the consumer a halfpenny contains many million plants.

When these yeast plants, well distributed through the dough, are set in a warm place, they begin to grow, and in order to grow they must consume food. Now, the flour and salt and water in the dough are very choice viands for these little plants. They assimilate some elements, and set free, among other things, carbonic acid gas. This occupies much more space than the carbon and oxygen occupied in the flour, and the gas as it expands "rises" the dough, rendering it light and porous. At the right moment off goes the whole mass to the oven, where the lives of the myriad budding plants are soon extinguished; and when we eat the bread, we eat the yeast cells along with the fragments of the cells of the wheat or rye of the flour.

Another familiar group of micro-organisms are the moulds: and still another group of lowliest, tiniest plants, closely allied to the fungi are the bacteria—elemental organisms so simple in structure as to be almost completely represented by lines and dots, but endowed with such limitless powers of reproduction as almost to shame the multiplication table. Under the most powerful lenses they are seen to consist of a minute mass of granular protoplasm, surrounded by a thin structureless membrane.

When we put them under favourable conditions of growth and give them food enough, they may be seen to divide across the middle, each portion soon becoming larger, and again dividing, so that it has been calculated that a single germ, under favourable conditions, might, at the end of two days, have added to the world's living beings 281,500,000,000 new individual bacteria. Indeed, if this sort of thing were to go on for a few weeks unhindered, pretty much all the oxygen, carbon, hydrogen, and nitrogen available for life sustaining purposes would be used up, there would be a "corner" in life-giving material, and even the master man would be forced to the wall. But numerous causes arrest their spread, and the bacteria, in the long run, are held closely within bounds.

Indeed, life goes hard with many forms, and but for a curious provision for their preservation under adverse circumstances, it is likely that many species would soon die out.

It is found that, when the conditions become too unfavourable for the continuance of life in some bacteria, a portion of the protoplasm sequesters itself in one end of the germ and surrounds itself with a dense resistent envelope. This is called spore. The old shell falls away, and this spore is now capable of resisting vicissitudes of temperature such as would have destroyed it in its other form. Restore the spore, however, to favourable surroundings, and it bursts its protecting shell, and emerges a thin-skinned vulnerable, but an active and perhaps a triumphant germ.

All of the bacteria, so far as we know, have the power, in nourishing themselves, of tearing asunder other forms of matter, assimilating a part of it in new combinations in their own bodies and setting free the rest. These chemical substances, which are set free by living, growing bacteria, are of the most diverse characters. They may be acid or alkaline, aromatic or bad-smelling, harmless or very injurious to man.

The soil forms the great living or lurking place of the more common forms, and from this they are spread far and wide into the air as part of the dust, or are washed off into the surface and other waters.

The life history of many of these species of bacteria is well known to us, while whole groups are almost wholly unstudied. This much has been well established, that there are some species which are quite indispensable to the higher forms of life in this world, because it is they which tear dead organic matter to pieces, and fit it to be taken up by plants and worked over into food for men and animals. A piece of meat, or any other organic matter, would remain unchanged indefinitely if shut up so that no living bacteria could come in contact with it. Under ordinary conditions, however, the bacteria do gain access to all dead organic matter, and then ensue putrefaction, and finally a total destruction—that is, a total change into other forms of matter. The bacteria are thus the great scavengers of the earth.

Others are injurious to man. It has been learned within the past few years that several of the most serious diseases known are caused by particular species of bacteria. Among the forms which thus originate are tuberculosis, Asiatic cholera, erysipelas, and some forms of blood poisoning, tetanus or lockjaw, some forms of pneumonia, typhoid fever and diphtheria. We know the germs which are concerned in the causation of these diseases, and can grow them in tubes in the laboratory and work out their life history.

Vast numbers of bacteria are taken into our system with a great variety of uncooked foods, and with water and milk; and of those which multiply in our bodies the great majority are inocuous, but a small proportion of them produce substance which act like poisons. These substances are called ptomaines.

It is difficult to conceive that all these curious doings, all these far-reaching accomplishments, should be carried on by organisms so small that 1,000 of them mustered abreast could pass through the hole pierced in a paper by a fine sewing needle and never touch the sides—yet so it is.

HEADACHES MAY BE SAVED.

A Swiss doctor says that many persons who extend their mental work well into the night, who during the evening follow attentively the programme of a theatre or concert, or who engage at night in the proceedings of societies or clubs, are awaked in the morning or in the night with headache. He is particular to say that he does not refer to that headache which our Teutonic brethren designate *Katzenjammer*, that follows certain convivial indulgences. This headache affects many persons who are quite well otherwise, and is due in part to the previous excessive work of the brain, whereby an abnormal flow of blood to that organ is caused: in part to other causes, for example, too great heat of rooms, contamination of the air with carbonic acid, exhalations from human bodies, and tobacco smoke.

For a long while the doctor was himself a sufferer from headache of this kind, but of late years has wholly protected himself from it by simple means. When he is obliged to continue his brain work into the evening, or to be out late at night in rooms not well ventilated, instead of going directly to bed, he takes a brisk walk for half an hour or an hour. While taking this tramp he stops now and then and practices lung gymnastics by breathing in and out deeply a few times. When he then goes to bed, he sleeps soundly. Notwithstanding the shortening of the hours of sleep, he awakes with no trace of headache. There exists a clear and well-known physiological reason why this treatment should be effective.

THE WEATHERWISE AND THE WINTER.

Meteorologists are like doctors, inasmuch as it is difficult to decide between them when they disagree. A short time ago some of the weatherwise came to the conclusion that the coming winter is to be even more severe than the last one. They based this theory on various grounds, among other reasons adduced being, first, that the storks in Holland had unanimously agreed not to extend their return tickets, but to leave for the south at the earliest moment: secondly, that the holly, ivy, and other hard-berried trees showed that Nature had provided a large store of food for the birds; and, thirdly, that we had had an exceptional plum year, and there is always some occult connection between frost and stone fruit, with many other reasons which, doubtless, appear valid to the person who discovers them. To them another class of meteorologists—which we may call the optimist school—replies that if the storks are leaving very early the swifts are staying preternaturally late, and a swift is quite as likely to be right as a stork, any way, and that last month was the warmest known since 1734, the winter of which year was one of the mildest on record, with other cogent reasons to prove their case. It is obviously difficult to tell which of these two doctrines is right. Nature is ridiculously wasteful, as she may have caused a glut in the stone fruit and berry market without any after-intention. It would be impossible for any bird to be as wise as a stork looks, but appearances are deceptive, and the swift, though a much smaller biped, is a more experienced traveller, and "keeps a pretty good grip on the handful of things he knows." On the other hand, September did not keep up the reputation it commenced with, and snow was reported to have fallen not only on Pilatus and the Rigi, but also at Annecy, which rather looks as though the pessimists were right in their prognostications. Perhaps, on the whole, it would be better if both classes obeyed the wise apothegm which an American millionaire is said to have invented, and never prophesied unless they knew. Weather reports are only another form of statistics, and statistics, as everybody knows, may be made to tell which way the statistician chooses. In meteorology it is a bad rule that won't work both ways, as Confucius is said to have remarked when he tried to double up a 2-foot measure in the wrong manner, and it is just as easy to find precedence to make your facts tell against what you wish them to prove, as it is to make them tally with your theory *Qui vivra verra*. Those who are alive next May will know which side proved right, but that will not be the faintest excuse for following their tip on a second occasion. In the meantime, it would be just as well to lay in a good stock of coal and firewood before the prices rise.

THE PRIZE SCIENCE SIFTING.

One Guinea will be paid each week to the contributor of the most interesting Science paragraph.

The paragraph must not exceed 200 words, and need not be original, but in this case, the source from whence it is copied must be given. All paragraphs must reach us on Monday, and be marked "Prize Science Sifting." Only one paragraph may be sent in by each competitor.

The Editor reserves the right of publishing any paragraphs sent in.

NOTICE.

Our first award will be made in the next issue.

THE AIR WE BREATHE.

The air is in constant motion, and every current of air, from the lightest zephyr to the blast of the hurricane, is called wind. The force which sets and maintains it in motion is the warmth of the sun's rays. These pass through the air without appreciably warming it, but impinging upon the surface of earth and ocean they are absorbed; and the heat being again radiated warms the atmospheric strata nearest the surface.

But the ratio in which the different regions of the earth are warmed varies considerably. Around the equatorial belt the sun's rays fall vertically or nearly so, and the heat is absorbed in a narrow area, but in higher latitudes the slanting rays diffuse an equal amount of warmth over a wider area. The zone of greatest heat has its centre north of the equator, owing to the fact that there is more dry land in the northern hemisphere, and that solid bodies absorb and radiate more heat than water. Over this warm region, which by no means covers the whole tropic zone, the heated air at the surface, becoming lighter by expansion, ascends through the cooler strata above it. It could not, however, continue to rise unless it were replaced, and this occasions the inrush from the north and south of cooler air, which in its turn gets warmed and ascends. The ascent of the upward currents is arrested as they reach a rarer atmosphere, and being debarred from falling back by the presence of ascending currents from below, they take a horizontal course towards the poles. A vertical ascending current of air is not regarded as wind, because there is no horizontal motion attending it, and the zone of ascending columns is consequently dreaded by the sailors as the region of calms. Occasionally the calm is interrupted by thunderstorms, due to the watery vapour which the ascending currents carry up with them. This, by its condensation in the upper atmosphere, forms clouds from which thunderstorms break out, liberating heat, which gives a new impulse to the ascending currents.

The warm, moist air rising from the regions of calms, and taking its course toward the poles, does not remain in the upper air. Even before it leaves the tropic regions it divides, giving off a vertical descending current, which, reaching the lower cool currents, is borne back to the torrid zone again. The regions through which it passes are again characterised by calms and storms. The main current, after having given off this descending current, continues its course toward the pole, approaching the surface of the earth nearer and nearer; until it reaches it in the temperate zone. Thus arises a double circulation, the lesser caused by that portion of the ascending current which descends near the edge of the tropics, and flows back to the equator; the greater caused by the main volume, which, descending gradually in higher regions, and becoming cooled, flows back over the surface toward the equator and is known, within the tropics, as trade winds. This double circulation would occur uniformly in all meridians, if the earth stood still, but as a consequence of the earth's motion, every current of air on the surface is appreciably deflected from its original course. As the earth revolves on its axis from west to east in 24 hours, every part of its surface, with its atmosphere, describes a circle greatest at the equator and lessening towards the poles. While a point on the equator is travelling 463 miles from west to east, a point under 45 degs. lat. traverses only 326 miles, and under 60 degs. lat. only 231 miles. Every place takes its own atmosphere along with it. If, then, a volume of equatorial air travelling at a speed of 463 miles an hour were suddenly transferred to the latitude of 45 deg., where the air has a speed of only 326 miles, it would generate a gale rushing from west to east at a speed equal to the difference *i.e.*, 137 miles an hour. While a volume of air transplanted from 75 degs. lat. to the equator would create a terrific hurricane from the east.

Happily such sudden transfers with their violent consequences do not actually occur. Nevertheless the aerial currents on their way from the equator to the poles and back again are subject to the influence of the earth's revolutions only gradually, and for that reason with less violent results. The equatorial current apart from its drift from south to north, is also subject to motion from west to east, imparted to it by the speed of the earth's revolution at its birthplace on the equator; and traversing regions in which the speed from west to east is steadily diminishing, it is deflected from its course of south to north, in an easterly direction, until the original south wind becomes a sou'wester. On the same principle the polar or return current on its way to the tropics, entering regions in which the rate of revolution is increasingly higher, gets left behind at every stage until the original north wind becomes nor'easter in the tropics. The trade wind in the northern hemisphere has consequently one invariable direction, entering the tropics as a nor'easter. No wonder, then, that Columbus's sailors, who knew nothing of the trade winds, argued from the prevalence of the nor'easter on their outward course, that they would never be able to return to Spain. The upper or counter trade winds, subject to the same law, pursue an opposite course at a height far above that of the highest mountain; the dust from volcanoes is, nevertheless, sometimes projected into and borne along by them.

WHY 60 MINUTES MAKE AN HOUR.

Why is the hour divided into 60 minutes, each minute into 60 seconds, etc.? Simply and solely because in Babylonia there existed, by the side of the decimal system of nations, another system, the sexagesimal, which counted by sixties. Why that number should have been chosen is clear enough, but it speaks well for the practical sense of those ancient Babylonian merchants. There is no number which has so many divisors as 60. The Babylonians divided the sun's daily journey into 24 parasangs or 720 stadia. Each parasang or hour was sub-divided into 60 minutes. A parasang is about a German mile, and the Babylonian astronomers compared the progress made by the sun during one hour at the time of the equinox to the progress made by a good walker during the same time, both accomplishing one parasang. The whole course of the sun during the 24 equinoctial hours was fixed at 24 parasangs, or 750 stadia, or 360 degrees. This system was handed on to the Greeks, and Hippalchus, the Greek philosopher, who lived about 150 B.C., introduced the Babylonian hour in Europe. Ptolemy, who wrote about 150 A.D., whose name still lives in that of the Ptolemic system of astronomy, gave still wider currency to the Babylonian way of reckoning time. It was carried along on the quiet stream of traditional knowledge through the middle ages, and, strange to say, it sailed down safely over the Niagara of the French Revolution. For the French, when revolutionising weights, measures, coins and dates, and subjecting all to the decimal system of reckoning, were induced by some unexplained motive to respect our clocks and watches, and allow our dials to remain sexagesimal, that is, Babylonian, each hour consisting of 60 minutes. Here you see again the wonderful coherence of the world, and how what we call knowledge is the result of an unbroken tradition of a teaching descending from father to son. Not more than about 100 arms would reach from us to the builders of the palaces of Babylon and enable us to shake hands with the founders of the oldest pyramids.

SOME SUPERSTITIONS.

The American negro and Indian races are very superstitious; their comings and goings, their up-risings and down-sittings, are governed by a series of invisible laws that would render life one long nightmare to a sensitive and trained intellectual race. Among the negroes, after death the soul of the dead is supposed to be hovering around, and many sevices are resorted to to appease the ghost, and to appease the ill will that may have been awakened by lack of reverence to the living and unseen portion of the departed in the handling of the dead. Still, if any person has a blemish —is lame, sick, bruised, or sore—he will not touch the dead, as his ailment is thereby rendered incurable; indeed, anyone who assists in caring for the body of a deceased person will be sure to carry away something belonging to the deceased, to insure him against visits from the "duppy," or ghost. The flight of certain birds over the house and back again indicates a sudden death in the family. The beautiful turtle dove, from the plantiveness of its note, is looked upon as a token of evil omen, foretelling serious misfortune or death if it lights upon the house. No "duppy" ever visits the living with good intent, but always to work harm. There are certain plants and trees given exclusively to be the habitation of the ghosts, and no negro will pass or handle one of the bewitched specimens of vegetation. The practice of dancing about the corpse is out of fear of vengeance to be now paid to any person from the ghost, as no one can make the circle who did harm (*i.e.*, administered poison) to the deceased, as he would if guilty, surely fall into convulsions and die miserably. Occult methods of obtaining poison from plants and deadly snakes obtain, and may be administered so as to defy discovery; hence this disgusting practice of the dance of the death circle. Remedies are prescribed of so simple a nature that if no good is done, no harm will follow. Tying knots in a bit of woollen yarn, a knot for each wart, walking backward, muttering "de spirits done settle down," with the knotted string held in the hand till near the fire, then rubbing the knots until slowly consumed, will cure the warts.

A similar formula over a bit of wet paper plastered on the chest will cure hiccoughs. The hand of a dead person slowly rubbed over sore eyes, with the same formula, only "de spirits done walk ober" added, is a sure cure. Pains can be conjured from the joints of rheumatic patients by repeating a charm, and whooping cough cured by placing a child under a charm. The faculty for seeing "duppies" is given to those persons who at birth had a caul over the face. This membrane is treasured by the family with much care, as the possession brings good fortune and the power to foretell coming events.

The Indians are quite as superstitious as the negroes, but they are a much more reserved and unsocial race, so it is much more difficult to ascertain the legends and explanations for their curious rites. An Indian will turn from his course and vary to the right or to the left without any explainable reason, apparently; he has come to a marching column of migrating ants, and has turned to one side to avoid crossing the route travelled by them. The worst of disasters would be drawn down on the unlucky mortal who failed to observe this rule. Birds are credited with having supernatural powers. The rain-croke, with its unearthly and melancholy cry, is a very prophet of evil. They are popularly thought to be the spirits of the departed come back to mourn and avenge injuries done to them in life. Eating together constitutes a sort of kinship and he who breaks the bond will be detected by the ticking of a certain beetle.

EXPANDING THE CHEST.

Proper expansion of the chest is necessary to good health, says Anna Ruppert, the celebrated dermatologist. A hollow chest is generally a sign of weak lungs. Consumption can in many ways be kept off by expanding the lungs and taking in plenty of good pure air. Most people who have consumption, encourage the disease rather than ward it off, by closely confining themselves, and consequently not obtaining fresh air enough to expand the lungs freely. Our dermatologist advises gymnastics, those which act on the chest and abdominal muscles, and plenty of out door exercise, riding and walking. When you arise from your bed, while still in your night clothes, rush to the window and draw in fresh air through the lungs, partly open the mouth and take in as much air as the lungs will admit, then allow it to pass slowly through the mouth half closed and the nostrils; be careful to allow it very slow passage. Take in fresh breath in this manner four or five times successfully each morning and see how rapidly you will improve by this simple method. Also kneading the flesh on the chest with first right and then left hand, and raising the arms high over the head repeatedly, is another form of expanding the chest. Now place one hand on the hips, the other on the opposite shoulder near the neck and draw several hard breaths; if possible rise early and walk around the room in night dress, repeatedly swinging the arms higher than the head. Do not "sag" while sitting down, but sit with shoulders erect. Sleep with little or no pillow.

ENERGY AND ENERGY.

Formerly, matter was considered as the thing that existed, and force the something that acted upon it. Energy is a term used to express something which we do not always understand. It exists everywhere so far as we know. Matter was considered indestructible. If we admit that energy can act on energy, we have no need of the old matter and force. We can see the changes in energy, though we cannot discover the thing itself. We have potential and active energy. Potential is simply stored energy, power to do work. The water in the reservoir is the same as the water a hundred feet lower, but it can do work that the other cannot, because it has energy stored in it. When that water is running down the hill and turning the wheel, it shows its actual energy. The earth revolving is another case of stored-up energy, as is also a wheel in motion. A spring is an example of elastic energy. In a boiler we have kinetic energy transformed from the heat of the fire. These are all mechanical forms of energy. The cannon ball shot into the air shows energy of motion in its ascent. When it reaches the highest point, it has energy of position. When it strikes the ground and bounds, it shows elastic energy. Besides this there is energy of temperature, which the hot cannon ball possesses. This is called molecular energy. If we could take all the heat out of anything, it would become liquid and then frozen. This has been done even to air. There is another or electric energy, another chemical and another radiant. Every form of energy is convertible into any other, sometimes at so great waste as to be impracticable for use. In converting mechanical energy into heat it is almost perfectly efficient, but in converting heat to mechanical motion ninety per cent is lost. The energy of heat is disorganised as contrasted with the organised, direct energy of motion. A disorganised army, each soldier going his own way, can do little. The tendency in nature is to degrade energy.

STEAM AND HAPPINESS.

To enumerate the present effects of the steam engine would be to count almost every comfort and luxury of life. It has increased the sum of human happiness, not only by calling new pleasures into existence, but by so cheapening former enjoyments as to render them attainable by those who before could never have hoped to share them. The surface of the land, and the face of the waters, are travelled with equal facility by its power; and by thus stimulating and facilitating the intercourse of nation with nation, and the commerce of people with people, it has knit together remote countries by bonds of amity not likely to be broken. Streams of knowledge and information are kept flowing between distant centres of population, those more advanced diffusing civilisation and improvement among those that are more backward. The press itself, to which mankind owes, in so large a degree, the rapidity of its improvement in modern times, has had its power and influence increased in a manifold ratio by its union with the steam engine. It is thus that literature is cheapened, and, by being cheapened, diffused; it is thus that reason has taken the place of force, and the pen has superseded the sword; it is thus that war has almost ceased upon the earth, and that the differences which inevitably arise between people and people are for the most part adjusted by peaceful negotiation.

FORGERY FOILED.

The Bank of England has probably the most elaborate system of guards against counterfeiting of any similar institution in the world. It relies not so much on the character of the engraving done on the notes, for this is poor as compared with the exquisite work of some foreign bills, but on the paper. This is made by a secret process, and ever since 1719 has been manufactured at the same mill in Tavistock. The paper is distinguished by its peculiar white colour, by its thinness and transparency, which prevent the use of chemicals or of the knife for altering or making erasures. The water-mark is produced in the paper while in a state of pulp, and a most artistic effect is caused by the gradual shadings of the mark in the substance of the paper. A distinguishing feature of the paper is its strength, since it is made of new linen, with but slight admixture of cotton. The paper used in a note is made much thicker in some places than others, so as to receive the vignette and ornamental printing, and splitting a note is impossible. The printing is done from electrotypes, made from a steel die, and the ink is a peculiar chemical composition, made, it is said, by a secret process, though the colouring matter is known to be prepared from the soot of burning coal-tar. Each note has an individuality of its own, a record being kept in the bank of its history, to whom issued and when, to whom and when paid. A note is issued but once, and when returned is kept for a certain considerable length of time and then destroyed. Notwithstanding these and many other precautions, however, the Bank of England notes have been repeatedly imitated, and numerous persons have been punished for counterfeiting them.

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Ten Guinea

prize; but, as these competitions will continue to the end of our first year, we have determined to award consolation prizes amounting to

One Hundred Guineas,

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but this prize will not be awarded to anyone who has received the

Ten Guinea

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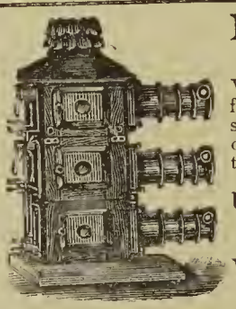

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SCIENCE NEWS & NOTES.

The Opening of Museums on Sundays

does not receive as much attention as formerly, nor, indeed, the attention it deserves. It is a question upon which the future of the people depends, for even the opponents of Sunday opening will hardly deny the educating and refining influence exercised upon the minds of the populace by the museums. There are many proofs before us that the opening of museums on Sunday would be taken advantage of by the multitude. Among them we may mention the Sunday popularity of the Metropolitan Museum of Art in New York. Since this museum has been opened on Sunday the average attendance on that day has been five or six thousand. The average church attendance is said not to exceed one-tenth of that ; therefore those who decline to be elevated by the church evidently do not view the museum in the same light, and who shall deny that the effect of beautiful pictures and statues does not equal anything than can be obtained elsewhere. Another point is that these institutions are the property of the public, and the great majority cannot avail themselves of the benefits to be derived from them.

Cheap Telephones

are nearer to our reach than is popularly supposed, and if the instruments really become accessible to the public at large, instead of only to the few as at present, they will revolutionise our whole system of communication, as they have done in other countries. The prevailing idea is that even renters of telephones should only pay *pro rata* for the amount of work they give the instrument, and this seems a fairer method than taxing everybody equally all round. Many have telephones in their offices and houses, and only use them very occasionally, while others are "ringing up" all day long. Therefore, the *pro rata* system would seem to be a just one. The means to this end come from Germany, where, in some telephone offices, an electrically driven clock is attached to each telephone, which will work as long as the receiver is off the hook, and stops directly it is replaced. The service is charged for according to the time recorded. It is claimed for this system that unnecessary conversations are prevented ; that those that take place are limited to reasonable length, and the useful efficiency of the whole is increased.

Man in 1991

is the subject we have chosen for our first literary competition, because we believe that it is an engrossing matter for most people, and, moreover, to those who are only even casually watching the advance of events and inventions, an idea easy of elucidation, and one that can be prophesied about with a fair amount of certainty. We might have asked our readers to write about 2891, but the conditions that will obtain a thousand years hence are too problematical for our purpose, and although even in the essay we have given, the imagination must necessarily have a certain license, we do not wish competitors to deal entirely with fiction, but to devote what they write as far as may be with possibilities.

A Thousand Years Hence

has, however, just been dealt with by that delightful novelist, Jules Verne, although in a most speculative fashion. Nothing will satisfy M. Verne but aerial trains travelling at the rate of 625 miles an hour, a trans-atlantic tubular service, conveying the traveller from London to New York in 295 minutes, a "telephote," which enables persons in different hemispheres to dine with each other, or, at least, to see and converse with each other while eating, and accumulators for condensing and radiating at will the sun's rays. Such are the advantages to be enjoyed by the inhabitants of a certain city called "Universal City," the capital of the United States in the year of grace 2891. The public will be kept informed of the latest political developments, not only upon the terrestrial globe, but upon Jupiter, Mars, and Venus. The newspaper of the day will be spoken. Brilliant descriptive writers (*sic*) will be retained to speak through the telephone to millions of subscribers, and daily instalments of novels, to be continued to-morrow morning, will be given by popular authors.

The Common Cabbage

is to all appearance a most uninteresting species of vegetable, although few domesticated plants possess such an interesting history to the botanist. It is in its natural state a sea shore plant, but slightly different from many of the seaweeds found in great abundance on rocky shores where warm currents prevail. Wild species of the cabbage plant are still found on the island of Lalandt, on the shores of Denmark, of Heligoland, on the southern and western coasts of Ireland, among the rocks of the Channel Islands, along the coast of France, Spain and Portugal, on the north shore of the Mediterranean, particularly along the Reviera, on the coast of Italy, and as far east as the islands of the Grecian Archipelago. The wild plant is small and hardy, is reproduced from seeds, and has the genuine cabbage flavour. The size of the cultivated plant is due solely to the careful attention paid it and the richness of the soil in which it is grown. Few plants have been cultivated from more ancient times than the cabbage, and the number of species has increased materially within the limits of written history. Theophrastus mentions three kinds, Pliny seven, Fournefort twenty, De Candolle thirty. The wild species has leaves much resembling the seed leaves of the cultivated cabbage, and has no appearance of a head, which, by some botanists, is considered a monstrosity.

The Evolution of European Science

is a question that does not disturb Chinese scientists, because the almond-eyed sons of Confucius take the flattering unction to themselves that Western science has been built up from the leaking out of the knowledge possessed by their ancestors to Western men, who cultivated it, improved upon it, and developed it. Hence they argue in favour of accepting foreign science and inventions in China, saying: "We wish to make use of the knowledge of Western men, because we know that what they have attained in science and invention has been through the help that our sages gave them. We have a good right to it. What Europe has done she has done through the help we gave. If we did not exactly give science to Europe, we gave it the fruitful germ which produced it. They have the science of optics, but in our Motsz we find that reflection from mirrors was known in the days of Mencius. The men of the West hold that the earth is round. This was believed also by our poet Chü Yuen, who, in his ode on astronomy, announces this doctrine; and this was not many years after Mencius. This being so, we ought not to be ashamed of the study of Western science. We are the rivals of the Western kingdoms, and it is good policy to use their spears in order to pierce their shields. We ought to train our youth in Western science, so that we may know how best to meet them in the struggle to resist their encroachments." There is considerable truth in this high-flown claim, although the bases of science to which it refers were of the most primitive nature. It must be admitted, however, that the first step is everything.

Dead Faces,

according to an indisputable authority, often change their expression from one of sorrow to one of pleasure, and *vice versa*. We recently heard of a lady who died of hæmorrhage of the lungs, brought on by the excitement of a violent quarrel with her husband, who had accused her of faithlessness. The face of the dead woman bore an expression of the most intense anguish. A few hours after her death proof positive of her purity was produced, and in half an hour the hard lines of the face had disappeared, and the face was almost smiling in its placidity. The husband was sure she was alive, and, as there was a doubt, a physician was called in. He came and made the most searching examination, but the woman was undoubtedly dead. Such a case as this reminds one of Hamlet saying, "There are more things in heaven and earth than are dreamt of in your philosophy." May not this singular phenomenon explain to some extent the changes that are said to have taken place in murdered bodies, in the mediæval ages, when exposed to the touch of the murderer? We agree, however, that it is a somewhat advanced theory to admit that any change whatever takes place in the expression of the dead, except such as is due to muscular relaxation, but this would hardly change an anguished expression into a smiling one. Placidity is the only thing we could expect from this cause.

Our Dread of Lightning

is only equalled by our ignorance of the means to escape from it. The technical press is full, just now, of the subject, and the various forms of lightning conductors suggested by experts are bewildering in their multiplicity. In Dr. Brewer's "Guide to Science," we find the primitive advice—when the lightning flash greets us in the night, to "wheel your bed in the centre of the room, and commend your soul to God."

The Eccentricity of Lightning

is remarkable, and its freaks are only equalled by the variety of effect it has on the different people it strikes. It is believed that a person who is killed by lightning suffers no pain at all. This is highly probable, as he never either feels or sees the flash. Some years ago a gentleman who was engaged in surveying in Minnesota was sitting in his tent during a thunderstorm. He was reading a book, and the next thing that he remembered was finding himself flat on the ground, with his servant trying to revive him. He had been struck, but he did not know it until he was told. He never saw the flash nor heard the thunder. Others who have been struck and have recovered tell the same story. A peculiar effect of a shock is the disturbing influence it exerts on the nervous system. Although the accident to which we have referred occurred years ago, the sufferer is always overcome by uncontrollable terror during a thunderstorm, and has the greatest difficulty in avoiding making a spectacle of himself. It is not fear of the ordinary kind that can be overcome by resolution, but an unreasoning panic of the nerves that is a true disease. The manifestation is nearly universal among those who have been struck. Death by lightning is probably the easiest in the world, for it is absolutely instantaneous.

Electrocution

would, therefore, be equally merciful, if instantaneous death could always be relied on; but it cannot. Indeed, in this respect, the electricity induced by human agency and the lightning of the heavens are equally unreliable. One case in especial has come under our notice. On the evening of April 25th last, during a violent thunderstorm, the lightning struck the lightning rod on a dwelling house, followed the rod until it came to a defective insulator, then entered the house, striking one of the occupants about half-inch back of the ear and burning its way the entire length of his body, then through a wool mattress, splitting a wooden bedstead, and afterwards passing through various parts of the house. After four hours of skilful work the unfortunate sufferer regained consciousness and is on the road to re-

covery, but his body is still so heavily charged with electricity that he can impart to anyone taking him by the hand a strong electric shock. This is a very remarkable case, and even with the authority we have, its strict accuracy may still be open to doubt.

The Census of Cheese,

or rather a piece of it, has been taken by an inquiring student of the microscope. It was found that the population of Emmenthal, a sort of Gruyere, was as follows :— In each gramme of the cheese, when fresh, from 90,000 to 140,000 microbes were found. This number increases with time. A cheese seventy-one days old contains 80,000 bacteria per gramme. A soft cheese twenty-five days old and much denser than the preceding has 1,200,000, and a cheese forty-five days old 2,000,000 microbes per gramme. The centre is freer than the outside. A cheese near the surface has from 3,600,000 to 5,600,000 microbes. According to the mean of these two figures, there are as many living organisms in 360 grammes of such cheese as there are people upon the earth. However, these figures, we hope, will not disturb our readers. We advise them to continue eating cheese just as they always have.

It is a Matter of Surprise

to the uninitiated that so small an object as the regulation screw can send a huge ocean steamer through the water at twenty miles an hour. The small size of the screw is not due to the perception of any inventor of its greater effect as compared with a larger one, but purely to accident. Formerly screws for steamers were made as large as possible, it being the theory that the greater the diameter the higher the speed. A vessel was launched with a screw so large that it was deemed best to cast each blade in two parts, and then weld them together. During a storm all these blades of the propeller broke at the welding, reducing the diameter by more than two-thirds. To the surprise of the captain, the vessel shot forward at a speed such as had never been attained before. Engineers then experimented with small propellers, and discovered that they were much more effective than large ones. Had it not been for this accident we might have gone on using large-bladed screws to the present day.

The Sun and Moon

appear to be larger when near the horizon, whether rising or setting, than when farther removed from that line. The reasons for these phenomena are because, when in that position, they permit a comparison to be made between them and the large objects on the earth whose magnitude is known, thus giving us a more exalted notion of the size of these celestial bodies than we could gain by viewing them near the zenith, and, again, the conception of their remoteness, and consequently of their volume, is heightened when near the horizon by the immense tract of earth swept by the vision in reaching them. In reality they are not larger at that time, but will be found to be smaller if the angle presented by their diameter were measured with sufficient accuracy. The sun and moon when near the horizon are farther away from us by the extent of the earth's radius than they are when in the zenith, and this would slightly reduce their apparent bulk if measured with precision.

Locusts

are a plague of which, happily, we know but little,with the exception of what we read in the press about the efforts made to exterminate them in Cyprus. But to those who come in contact with these insects in their myriads, they are far from an object of indifference. Only recently a telegram from Algiers, gave particulars of the horrible fate met by the French savant, M. Kunckel Herculais, the president of the Ethnological Society, who was employed on the government mission of investigating the locust plague. While examining a deposit of locusts' eggs he was overcome with fatigue and the heat and fell asleep on the ground. While sleeping he was attacked by a swarm of locusts. On awaking he struggled desperately to escape from the living flood. He set fire to the insect-laden bushes near him, but all his efforts proved ineffectual, and when finally the locusts left the spot his corpse was found. His hair, beard and necktie had been entirely devoured. M. Herculais was a great authority on insects. His death is another proof that the meanest things in creation are to be feared in combination.

The Rain-Makers of America

have not been as successful as the Eiffel Tower in producing rain. It is said that the great tower attracts so much atmospheric electricity as to cause great cloudiness and increased rainfall in the vicinity of Paris, and yet the County Council is permitting speculators to further endanger, as far as London is concerned, the few fine days we are now blessed with.

The Rise and Fall of Nations

of antiquity may be traced by the study of comparative philology, and the history of any art or industry is also reflected in that science, while the number of words which are contributed by a given profession may, to a certain extent, be taken as a measure of its importance. Thus the most influential guild of American colonial times was the ship calkers of Boston. In those days a meeting of the calkers was usually held to decide upon political or other questions and was called a "calkers," hence our Latin-looking word "caucus," which thus originated over the Atlantic. In this way one word was added to our language, but the electricians have given us a whole dictionary. In this case, certainly, the relative importance of the two industries is correctly represented by the numerical value of the words introduced by each.

Electricity

has, in many ways, affected language, and in many other ways will it continue to do so. The word restriction of the telegraph and the time limit of the long-distance telephone have imparted a telegraphic brevity to our style which is not altogether to be deplored, especially as it quickens the revolt against the long-winded two-volume novel in favour of the short story,which is constructed with some reference to the amount of time at our disposal during this life here upon earth. In speaking of the short story, no less an authority than Edgar Allan Poe says that it is that class of composition which should best fulfil the demands of high genius.

The Future of Letters and Style

will be greatly influenced by the phonograph. In fact, by it have those very words themselves been restored to the original meanings which they had in the time of Pliny. How appropriate it is to call the wax record of the phonograph a letter, for that word is from the Latin *linere*, *litum*, to besmear or rub over as with wax, and one of the first means of writing adopted by primitive man was by graving

upon wax-covered tablets with a stylus (hence our word stylus), which was a sharp-pointed instrument made originally of metal. But after a Roman schoolmaster was killed by one in the hands of a pupil, horn was substituted. Although destined to play a most important part as an educational adjunct, the phonograph as yet has no place in the schoolroom; but if introduced in its present form, it would make the death of the Roman schoolmaster seem euthanasia, compared with the fate of the modern pedagogue at the hands of the small boy.

Phonographic Letters

will be general some day throughout the country, and they should have a bracing effect upon the art of elocution, which seems to have been forced into a secondary position by the great magazine and daily newspaper of the present age. One of the developments that may be confidently expected is the phonographic dictionary, which will be so constructed that the busy correspondent, by simply touching a button, may have any word properly spelled, pronounced, and defined, with the usual etymological data appended, all given in the most approved tones of the elocutionist's art. The horological phonograph, which will announce the various hours of the day, with a few remarks appropriate to the time, has not yet made its appearance among us, but will come with the perfected machine. When it does come, it will no longer be necessary to get up in the cold at night to strike a light in order to find out the time, for, by remaining in bed and simply touching a button, the hour, minute, and even second will be announced to you with all the politeness of a trained servant. In the art of music the phonograph will work its greatest change. Let the makers of music and musical instruments study this instrument and study it well. Its greatest wonder is yet to be told.

Asbestos

is destined to revolutionise many existing trades, but in one direction it will prove invaluable. It is absolutely indestructible by fire, and in time paper money and paper for important documents, such as deeds, mortgages, notes, wills, and other similar instruments, will probably be made wholly or in part of asbestos. Nobody knows how much money in the form of bills is destroyed every year in fires, and one can only conjecture how great is the loss from the destruction of account books and valuable papers. With these made of indestructible paper, a merchant will not be ruined by the loss of his books, for after his warehouse burns down he will dig among the ashes, recover his accounts and go on with his business. The man who accidentally throws a piece of paper money in the fire with a handful of waste will be able to take the tongs and get it out again, while the family stove will be, as heretofore, a favourite, but positively safe place of deposit for a spare five pound note!

Sneezing One's Teeth out

is a novel notion as far as Europe is concerned, but we are told, on no less an authority than that of the physician in charge of the Ningpo Missionary Hospital, that the Chinese dentists remove the teeth by causing the patient to sneeze. These dentists possess a wonderful powder, which is rubbed on the gum over the affected tooth. After an interval of about five minutes the patient is told to sneeze, whereupon the tooth falls out. A dentist has, we hear, offered a large reward to any one performing the operation in this way in his presence, on condition that he is allowed to choose the tooth and examine the mouth before and afterwards. So far no one will consent to perform the operation on these conditions. We strongly counsel the British Dental Association to send a commission to China to inquire into this very interesting statement.

Zeno of Elea,

the double-tongued, the all-confuting, held that motion was simply the product of men's imagination; that things merely seem to move, and do not actually do so. He supported this position by this sophistry: "Motion is supposed to be in space. Then, if it exists, it must exist in some place. But a thing cannot move in a place where it is. Neither can anything move in a place where it is not. Motion is, then, impossible."

The Effects of Alcohol

on digestion have been minutely tested of late; the results have not been altogether in favour of strict tectotalism, as they contrast strongly with the tectotal lecturer's experiment showing how digestion in a glass vessel is retarded by alcohol. It was found that a small dose of strong alcohol—*e.g.*, brandy—shortens the time that food in general, whether animal or vegetable, or a mixture, remains in the stomach by more than half an hour. A similar but not quite so marked an effect is produced by a dose of hydrochloric acid or mustard. Pepper diminishes the time the food remains in the stomach by about a quarter of an hour. Beer and an infusion of rhubarb has no effect.

Gold in Solution

is said to be contained in sea water, and a number of chemists have interested themselves in analysing the water of the sea for the purpose of settling this much-ventilated question. The results of their investigation have proved beyond a doubt that sea water contains both gold and silver. A number of chlorides, sulphates, bromides and iodides found in the water of the sea have, to a limited extent, the power of dissolving the two precious metals. A distinguished German chemist some years ago determined, by actual experiment, that a ton of sea water contains one grain of gold, held in solution by the iodide of calcium. The quantity of silver is much larger. Sheets of copper taken from the hulls of ships which have sailed through the tropical seas are often so rich in silver as to be worth smelting. One of those statisticians who are fond of dealing with immensity, calculates that the sea holds in solution over 2,000,000 tons of silver, or about £15,489,600,000, a sum about ten times as great as the entire computed silver product of the world from the earliest times to the present day. No available process has been invented to extract the precious metal from the water, however; so, for all practical purposes, it is lost to the world's use.

A Remarkable Meteor

was recently found in Arizona, U.S.A. It was so extraordinarily hard that a number of chisels were destroyed in cutting it, and the emery wheel used in polishing it was ruined. Cavities were reached in cutting it, which were found to contain diamonds, small and black, and of little commercial value, but of the greatest mineralogical interest. Shapeless granules of carbon were found within the cavity, in which a minute white diamond was revealed by treatment with acid. The general mass of the stone contained three per cent of nickel. Diamonds were previously observed in a meteorite by

two Russian mineralogists in 1887. Theoretical speculation has failed, so far, to account for the singular formation of these meteorites.

Suicidal Tendencies

are not confined to man. Earth-worms, besides the active enemies which are seeking to destroy them, have a habit of seeking destruction on their own account. On any wet morning the shallow puddles in the roadways and elsewhere are often occupied by the dead bodies of earth-worms, or by individuals at their last gasp. Have these worms voluntarily sought a watery grave? or do they represent, as Darwin thought, merely the sickly and dying individuals that have been washed out of their burrows by the rain? Darwin's explanation is probably correct, but it is also credible that the heating of the puddles by the sun's rays has something to do with the great mortality of the annelida. Cold fresh water seems to be practically harmless, although salt water is rapidly fatal to earth-worms.

Savage Tribes,

in nearly every instance, show some cases of woman's political domination. This is especially noticeable in Eastern Asia, among the aboriginal peoples whom the Chinese found on Yellow River on their arrival from Akkad. The Chinese then possessed the rudiments of civilisation, of which the aboriginals were then destitute. That this irruption of the Chinese was anterior to the invention of cuneiform writing in Akkad was probable, because of their use of *quipos* or knotted cords in keeping records. These *quipos*, and not mere tradition, were the base of Chinese archaic annals, and from them the earliest form of Chinese written characters was evolved. Anterior to these *quipos*, judging from certain neighbouring tribes, notched sticks were employed. As to the tribes which the Chinese found existing when they reached their future home, the philosopher of Universal Love, Motzu, enunciated views on the evolution of the state and family which are in accord with those of modern anthropologists.

Men at first

were in the lowest state of savagery; there was no golden age, as depicted by sages and political philosophers, until men felt a necessity of a remedy for the anarchy that prevailed. Some of the practices of self-deformation were remarkably curious—as, for instance, those of drinking through the nostrils, extracting front teeth and substituting dogs' teeth, head-flattening, etc.; the most striking was the attempt to raise a polydactylous race, by destroying all children who came into the world with the usual number of fingers and toes. There have been many instances of rule by Amazons, and it is mostly among aboriginal inhabitants that the chieftainey of women obtains to this day. There is seldom an age of which one tribe or another does not afford examples; the more primitive the condition of these tribes the slighter is sexual differentiation as regards public governmental affairs. The fables and myths in Greece respecting Indo-Scythian Amazons arose chiefly from rumours respecting tribes of this kind.

IDEAS & INVENTIONS.

Any of our readers possessing ideas, or inventions which they may consider worth patenting, may communicate, free of charge, with our Patent Editor, whose experience in this department, warrants us in believing that the advice given will be sound and practical.

GLEANINGS OF THE GLOBE.

DRY air is heavier than moist air.

THE elephant's trunk contains over forty thousand distinct muscles.

THE earth is estimated to weigh 1,256,195,670,000,000,000,000,000 tons.

LIGHT through the new Lick teleseope is nearly two thousand times as bright as that seen by the naked eye.

THE atmosphere extends to a height of from forty to fifty miles above the surface of the earth.

DR. DOWD, of New York, has found that each cubic ineh of soil contains from 60,000 to 2,250,000 minute organisms.

A FACT little known is that light travels more quickly through a vacuum than through our atmosphere; the respective velocities are 192,500 and 192,000 miles per second.

ALTHOUGH some articles may seem warmer than others, every article in a room is of the same temperature assuming all to stand in the same relation to the sun.

THE muscle of the calf of the leg has been found, when removed from a dead body, to be capable of sustaining a weight equal to seven times the weight of the entire body.

THE estimated amount of salt in the sea is 3,051,342 cubic geographical miles, or about five times more than the mass of the mountains of the Alps.

THERE are insects termed gossamer spiders that build their own balloons, and thus float through the air. They are unendowed with wings, but Nature has furnished them with this curious means of locomotion.

THE total amount of atmospheric pressure on the earth's surface, at 15 lbs. to the square ineh, amounts to 12,042,604,800,000,000,000 lbs. This pressure is equal to that of a globe of lead sixty miles in diameter.

LIGHTNING is *zig-zag* when it travels through a long distance; *straight* when it passes through a short distance only; *forked* when it encounters resistance of the air; *sheet* when the flash is very distant and seen only by reflection, and it is *blue* when the electrical excitement is very intense.

THE great naturalist Linnæus distinguished thus between animals, plants and minerals. Animals grow, live and feel; plants grow and live; and minerals grow. This definition has in latter days, however, been held to be somewhat unsatisfactory, for there are a few plants more sensible to feeling than some animals.

THE Prince of Monaco's new yacht, "The Princess Alice," is equipped with all the latest appliances for scientific research on and in the ocean. MM. Leblanc and Eudes, of Paris, have furnished all the instruments for the new science of oceanography, as it is termed. An immense photographic equipment and laboratory is not the least important feature in the yacht's fittings.

The lobster is greatly in dread of thunder, and when the peals are very loud numbers of them drop their claws and swim away for deeper water. Any great fright may also induce them to drop their claws. But new claws begin at once to grow, and in a short time are as large as the old ones, and covered with hard shells. The lobster often drops its shell, when it hides until the new one is hard enough to protect it.

The rate of travel of thunder-storms has been studied by Herr Schonrock, from the record of 197 such storms in Russia in 1888. The velocity is found to have varied from thirteen to fifty miles an hour, with a mean of 28·5 miles an hour in the hot season and increasing to thirty-two miles an hour in the cold season. It was least in the early morning, increasing to a maximum between 9 and 10 p.m. The storms travelled most quickly from south-west, west, and north-west.

According to an American contemporary, foreign languages are now taught in some of the cities of the States by means of phonographic cylinders. Sets of these are also supplied which contain a conversational course of French or German, each phrase numbered to correspond with its written characters in a book which serves as a key to the sentences with which the cylinders are charged. In this way, ear and eye are simultaneously informed, and the difficulties of pronunciation considerably smoothed.

In the electrical works of Johann Frederick Hartmann, published in Hanover in 1759, 1764, and 1766, there is an account of several very curious experiments. One of the most interesting demonstrates the progressive motion of the electrical discharge. When the shock was passed through a great number of cannon balls (sometimes as many as forty) placed upon small drinking goblets close by one another, all the sparks and all the cracklings were heard at the same moment, but when eggs (preferably ten or twelve) were substituted for the balls, the progress of the explosion was visible, every two giving a flash and a report separately.

The average weight of the brain of man bears a definite relation to the climate in which he lives, a heavier brain weight being found in cold than in warm countries. In proportion to their stature the Lapps have the largest heads in Europe, the Norwegians next, then come the Swedes, Germans, French, and Italians. In the Arab the head is found to be smaller than any of the above, while in the far North there exists a people called the Chugatshes, whose heads are remarkably large.

An eminent statistician of Germany has recently given out the following as general facts, proved by vital statistics: The average length of life is thirty-seven years. Twenty-five per cent of mankind dies before attaining the age of 17. Of 1000 persons only one reaches the age of 100 years, and six that of 65 years; 35,214,000 die every year, 96,480 every day, 4020 every hour, 67 every minute; the births amount to 36,792,000 every year, 100,800 every day, 4,200 every hour, 70 every minute. Married people live longer than the unmarried, and civilised longer than the uncivilised. Tall persons enjoy a greater longevity than small ones. Women have a more favourable chance of life before reaching their fiftieth year than men, but a less favourable one after that period. The proportion of married persons to single ones is as 75 to 100. Persons born in spring have a more robust constitution than those born at any other season. Births and deaths occur more frequently at night than in the daytime.

THE PRIZE SCIENCE SIFTING.

One Guinea will be paid each week to the contributor of the most interesting or curious Science paragraph.

The paragraph must not exceed 200 words, and need not be original, but in this case, the source from whence it is copied must be given. All paragraphs must reach us on Monday, and be marked "Prize Science Sifting." Only one paragraph may be sent in by each competitor.

The Editor reserves the right of publishing any paragraphs sent in.

We have awarded the prize of One Guinea to Mr. F. McIntyre, of 67, Globe-road, E., for the leading "Science Sifting." The other siftings published all deserve honorary mention. We have received nearly 3,000 post cards for this competition.

The Peculiarities of Frogs.

Anyone who has kept frogs or toads must have noticed one remarkable thing about them, and that is their habit of swallowing their skin. For the past eighteen months I have had several of these reptiles in my possession, and have often observed the process of changing. First of all the skin splits down the back, then after sundry wrigglings the hind legs are freed and the fore legs soon follow. Then the frog or toad draws the skin into its mouth. For several hours after, the reptile's body appears to be very moist.

Foretelling the Weather.

In cloudy, doubtful weather look in the sky and select the smallest cloud that you see; keep your eye upon it, and if it decreases and disappears it shows that fine weather will follow; but if, on the other hand, it increases in size as you are watching it, this is a certain sign that it will soon rain. The reason is this, that when the air is becoming charged with electricity, every large cloud attacks all the smaller ones, swallowing them up as it were, and generally ending in a shower. On the contrary, when the electric fluid is passing off or diffusing itself, then a large cloud will break up into a number of small ones, and dissolve out of sight, leaving behind a bright, clear, blue sky.

V. Tudor, 6, Edbrooke-road, Paddington, W.

Age.

Few men die of age. Almost all die of disappointment, passional, mental, or bodily toil, or accident. The passions kill men sometimes, even suddenly. The common expression, choked with passion, has little exaggeration in it, for even though not suddenly fatal, strong passions shorten life. Strong-bodied men often die young—weak men live longer than the strong, for the strong use their strength and the weak have none to use. The latter take care of themselves; the former do not. As it is with the body so it is with the mind and temper. The strong are apt to break, or, like the candle, to run; the weak burn out. The inferior animals, which live in general regular and temperate lives, have generally their prescribed term of years. The horse lives 25 years; the ox 15 or 20; the lion about 20; the dog 10 or 12; the rabbit 8; the guinea-pig 6 or 7 years. These numbers all bear a similar proportion to the time the animal takes to attain its full size. But man, of all the animals, is the one that seldom comes up to his average.

T. H. Brockell, 8, Courtland-terrace, Kensington, W.

Fertilisation.

When we see the bees and butterflies flitting from flower to flower, we are apt to image that the advantage is one-sided. Yet, strange as it may appear to the uninitiated, the flower receives as much, often more, benefit than the insect. To produce good seed, the ovules or undeveloped seeds must be fertilised, that is, the pollen must fall upon the stigma or top of the ovary. Once there, each grain must send down its slender projections into the ovary and discharge its contents upon an ovule. Every ovule which receives this matures into a seed, the rest die. Most plants have their stamens so placed that the pollen will fall upon the stigma, but many have the stamens in different flowers, and some on different plants. Hence the value of the visits of insects, which carry the pollen on their legs and wings from one flower to another. Without them no seed could be formed in these plants, except by the uncertain aid of the wind. Again, even those plants whose stamens are conveniently placed for *self-fertilisation* produce better seed if thus *cross-fertilised* with pollen from an allied species. Many flowers seemed to lay themselves out to attract insects by means of honey, scents, and brilliant colours.

E. F. O'Brien, The Glen, West End-lane, N.W.

The Causes of Dreams.

Dreams may be divided into two classes, according to the manner of their origin. (1) Dreams induced by nerve stimulation. These are by far the most numerous. The nerve stimulus is felt (for if a sleeping person is tickled he will rub the place), a memory picture arises, and a perception results. The picture does not, however, correspond to the actual stimulus. For instance, if a sleeping person be sprinkled with water, he will dream of a shower of rain. (2) Dreams induced by the association of ideas. They are caused by the activity of the brain, and not the result of mere stimulus. The subject of the dream has generally some relation to the object of the brain's activity during the previous day.

B. Brooke, 120, Falsgrave-road, Scarborough.

Peculiarities of Sight.

Science has not yet told us why we do *not* see things upside down. It is an absolute certainty that the image formed in the eye is inverted; just as the lens of a magic-lantern inverts the picture painted on the slide, so the lens in the eye (which lies just behind the little hole we call the pupil) forms on the retina a reversed image of anything we look at. It has been suggested that experience gained through the sense of touch teaches us the real position of objects in early infancy. If this is so, the first impression formed by a baby of its "dad" is that of a great monster who walks on his head!

Leone G. Chiozza, 36, Colverstone-crescent, N.E.

An Interesting Theory.

A few days ago I happened to be watching the particles of dust floating in a sunbeam, and I was much struck with the fact that no two of them ever came in contact. I have watched frequently since and find this is invariably the case. Some electrical or other principle is evidently involved in this, and I do not think it has been before observed. May not the same principle be involved in connection with the orbs of space?

S. Hodges, The Firs, Ealing, W.

WHEN THE WORLD ENDS.

Every generation has its own hardships and privations to endure, and is quite justified in refusing to afflict itself with the possible sufferings of its remote posterity. Therefore, although we are frequently presented with vivid pictures of the distressful state in which the inhabitants of our globe will find themselves as the planet approaches its final catastrophe, and all forms of life are successively extinguished we doubt if any keen emotion was ever excited by that dismal but very distant prospect. It is at most a feeble and transient regret that we feel, not to be compared to the lively sympathy aroused in us by the fictitious woes of the heroine of a romance. For in the latter case the calamities depicted are such as somebody has actually suffered, or is liable to suffer, and they appeal directly to our personal experience; in the former they are almost infinitely remote, and we can persuade ourselves that they are conjectural if not wholly imaginary. Whether they will ever have any real existence in the definite form which we ascribe to them, is a question about which a rational view of the case raises very serious doubt. In the first place, the end of the world, if it comes by the orderly operation of known causes, as is here supposed, will not come in the sudden manner which is the chief condition of its dreadful impressiveness. We are not now speaking of the end of the world as set forth in the Book of Revelation, nor yet of the violent and instant destruction which might overtake it by collision with some vagrant celestial body; but of the extinction of life upon its surface either by the loss of its internal heat and consequent freezing out of all vital organisms, or, contrariwise, of its being drawn steadily towards the sun and becoming at length a fiery orb in whose intense heat no plant or animal can live. An appalling picture is drawn by those adopting this theory, of the sufferings of the earth's inhabitants as their doom approaches, and the limits within which they can exist become narrower. Food supplies fail, millions die by famine, the heat and drought become insupportable, the rivers dry up, lakes and seas are evaporated, and the clouds thus formed are dissipated by the fierce solar rays. If any human beings still linger, sunstroke will soon exterminate them, and all organic life will speedily disappear. The story is told as if these harrowing events were all to be crowded into a single year, or at most a decade or two—in which case, admitting the theory on which it rests to be correct, it cannot be fairly objected that the picture is overdrawn.

That something of this kind may be the ultimate fate of mankind we are not prepared to deny. And if the world is to come to an end at all, there must some time, of course, be a Last Generation and a Last Man; although whether they will be aware of themselves as such is a very doubtful question. Nor will their experiences and sensations, even in that case, differ essentially from those which have been undergone by thousands of their predecessors in other ages of the world. A traveller lost in the desert and lying down to die of heat and thirst is exactly in the predicament of the Last Man. The victims of great catastrophes feel precisely as the Last Generation might be expected to feel, supposing it to be similarly destroyed; and it is not unlikely that some of them, in the blind terror of the moment of disaster, may have taken for a world-wide catastrophe what was in fact a local disaster. But the point which specially deserves attention is this—that the approach of the human race to extinction will be, we may reasonably expect, gradual and prolonged rather than swift and immediate. It will not come upon mankind as a sudden stroke of doom, but will be drawn out through ages of slow and scarcely perceptible change. In

fact, we are now in one stage of that long progress of our globe from its formation and its uninhabited state, on through innumerable centuries of surface and climatic changes, of areas first vacant and then occupied, or first peopled and then deserted, and so on to far distant time when either the frozen or the torrid zone will have made a full conquest of its neighbour. It would seem that we are already far advanced on this journey, since a large part of the globe is either dead or still wants to be warmed into life. Within 10 degrees of either pole the end of the world has already come—or else its beginning has not yet dawned. Still we are not conscious of any transformation, either by cooling or roasting. Neither by the experiences of a single lifetime nor by reference to the annals of several thousand years can we perceive ourselves that the race is being surely, if never so slowly, driven from its foothold upon the planet. It does not even occur to us as a strange or disquieting fact that great spaces on our earth should be icy wastes, uninhabitable and inaccessible. If we were living, and had lived for uncounted centuries, on an equatorial strip but a few hundred miles wide, all our conditions would be as accustomed and our state of mind regarding them probably as little perturbed as now. And what is true of our present state, transitional as it undoubtedly is, and would presumably be true if our situation were vastly more confined than now, will apply equally to our remotest descendants, down to the end of time. We say to the end, not presuming to decide whether the champions of combustion or those of congelation, as the method of our final taking off, are correct in their particulars. In either case, we doubt if the last sufferer will realise, as fully as we imagine, his claims upon the sympathy which we are prematurely extending to him.

MAKING PLANTS GROW BY STIMULANTS.

French scientists are interested in recent electrical experiments upon plants by Mr. Celi. He took two bell glasses of the same size, and under each of them placed a flower pot. These pots were filled with earth of the same nature, and in each of them he sowed three kernels of Indian corn of the same weight, which he watered with the same quantity of liquid. The air was constantly renewed under the two bell glasses by aspirators. One of the glasses was arranged as follows :—

An aperture at the top gave passage to a wire that ended within the glass in radiating points.

Outside of the glass this wire was in communication with an insulated metallic vessel, placed two metres above the bell glass and filled with water that flowed out through a very fine aperture. Through such flow, the vessel became electrified with the same electricity as the air, in most cases positive. This electricity was led to the small crown of points, and was thence dispersed in the air which filled the bell glass.

Ten days after the seeds had begun to germinate the height of the plants was as follows : In the electrified air, 17 centimetres ; in the non-electrified air, 8 centimetres, The result was, therefore, favourable to electricity.

From various experiments M. Selim Lemstrom draws the following conclusions ;—(1) Plants are divided into two groups. One, the development of which is favoured by electricity, comprises wheat, rye, barley, oats, red and white beets, parsnips, potatoes, celeraic, beans, raspberries, strawberries and leeks. The other, whose development is more or less interfered with by electricity, comprises peas, carrots, rutabaga, kohlrabi, turnips, white cabbages and tobacco.

PHRENOLOGY EXPLAINED.

By Stackpool E. O'Dell.

Author of "Phrenology: its Truthfulness and Usefulness," "Old St. Margaret's," "Merciful or Merciless?" "Brompton Lectures," "Mental Troubles," etc.

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IV.

The organs that we denominate perceptive are denoted by size, combining width and prominence, over the eyes. It is objected that the *frontal sinus*, which is a cavity between the two tables of the skull averaging about half-an-inch in length, underneath the organs of individuality, locality and form, interferes with a phrenologist forming a judgment concerning the strength of their functions. Our reply is that this frontal sinus is not formed until the perceptive faculties are much developed ; secondly, that the experienced eye can make allowance for the frontal sinus ; and, thirdly, that a multiplicity of observations prove to us that size in this region is accompanied by power. The organ of individuality, which is just above the root of the nose, gives the individual the faculty of being able to distinguish one object from another. Some people see things in their combination ; they see a street, for instance, but they do not individualise the houses in the street. They see a wood, but they do not individualise the trees ; they perceive a crowd, but they do not individualise the people ; or they go into a strange room, they know it is furnished, but they are not able to individualise any single article of the furniture. Such are deficient in the faculty of individuality. Where the faculty is large and active, the eyes will perceive one thing separate from another, and will have a desire to understand the distinguishing marks of each. In this we perceive the utility of this faculty in every department of life. The mere desire to see, and the ability to individualise what is seen, gives us no idea of the form, size, and colour of what we see. There are other faculties for this purpose. An individual may look at an object and come away with a most indistinct impression of the qualities of that object. This is often the case. The organ of individuality, like all the other organs of the body, can be cultivated and developed by exercise. Where it is deficient an effort should be made to separate one thing from another, valuing and judging according to individual standards and merits. For this purpose we bring to our aid the other perceptive organs, and each organ should be trained to do its own work. The organ of form, which gives width between the two eyes, enables us to perceive the formation of bodies. In a general way we know the difference between round and square, but if we compare this knowledge of the formation of things with that which the trained, artistic mind has, we perceive how inefficiently it is cultivated. There is a beauty in form which we scarcely understand. If properly cultivated, this one organ alone would open up to us a wide field of pleasurable observation. How much more edifying and instructive our museums, our picture galleries, or the great national wealth of sculpture we possess would be, if we could admire the variety and beauty of form. The best teacher of form is Nature. Take the leaves of flowers, shrubs, bushes, trees. Compare them one with another in regard to their form. Try to understand the hundreds of varieties, not as a task, but for the purpose of discovering beauty in each. If the eye is thus trained, both Nature and Art will open up a wealth of beauty, now incomprehensible. The training of this organ will be of great assistance to our memory. Let us remember as we go on that each organ has a memory of its own, which

will be in accordance with its size and activity. If the faculty of form be cultivated we shall be able to remember things on account of their formation, and everything has a formation. We shall know trees, shrubs, flowers, by the formation of their leaves. We shall remember the form of a face, the form of a coat or a dress. This, we perceive, applies to everything, thus assisting our memory in regard to all things so far as form is concerned. Children at a very early age should have this organ trained by pointing out to them the special formation of individual objects. The next organ in the perceptive group is size. Unless the eye is specially trained in regard to measurement, we are rather backward in our conception of size, either in regard to standard measurement, or from a comparative point of view. With a little practice by the aid of a measure, we should soon be able to know inches, feet, yards, furlongs, miles—that is, we could gauge measurement by the eye. This, too, would be an assistance to our memory. We shall be able to remember an object from its formation and its size. Comparative size appeals to the organ of sublimity. Switzerland is appreciated on account of the size of its mountains.

EDISON TELLS HIS TROUBLES.

"Won't you tell me about the first carbon lamp you ever made?" asked an American reporter of Mr. Edison.

"Ah, that is a story. The carbon of the first lamp was made of a spool of Clark's thread. All night Batchelor, my assistant—the greatest and best of my assistants, the man of infinite patience and indefatigable persistence — worked beside me. The next day we worked all day and then all night again, and at the end of that time we had produced one carbon out of a spool of Clark's thread.

"Having made it, it was necessary to take it to the glass-blower's house. With the utmost precaution Batchelor took up the precious carbon, and I marched after him, as if guarding a mighty treasure, to the glass-blower's cubby-hole. To our consternation, just as we reached the glass-blower's bench, the wretched carbon broke.

"Batchelor turned around and looked at me and said: 'Edison, we won't sleep till we get one.'"

At the recollection Edison lay back in his chair and laughed heartily. When he recovered from the fit he said:

"That was one of Batchelor's perpetual phrases, which he said to me a hundred times before, and which I said to him. We turned back to the main laboratory and set to work again.

"It was late in the afternoon before we had produced another perfect carbon. The same procession as in the morning passed to the glass-blower's den. It was safely deposited on a bench, where Batchelor laid it down, when a jeweller's screw-driver—a very little utensil, as you know—rolled down and broke the carbon again.

"But we turned back again, and before night the carbon was completed and inserted in the lamp. The lamp was exhausted of air and sealed, the current turned on, and the light that is to be the light of the world met our eyes for the first time in all its beauty."

A French scientist, M. d'Arsonval, has made a most interesting discovery, viz.: that if a bright light be projected upon a frog's muscle, which has been stimulated with a weak induction current which produces no visible effect, it will slightly contract. In other words, light will, to a lesser extent, do what electricity does. These identical effects provoke much speculation.

HOW TO TRAIN AND TREAT THE BRAIN.

It is becoming a very practical question how much work a brain can perform, and under what conditions it can do its best work. That which we call genius is often nothing else than the natural growth of organs and faculties, which of necessity grow by their use. All productions are the results of labour, physical and mental, applied to natural objects. Before genius is application. The mind must be fertilised by knowledge and made prolific by industry. Surely each of us may at least do as well as Hierocles, who, after the labours of his life, left a legacy of twenty-one good jokes. If they were good jokes he might have done worse. This is to bring brain work down to a very common-sense level. Great achievements are not inspiration, they are the result of work. An ability to work is then the first point to be considered and aimed at. Half the aim of education is to enable a man to apply himself—the other half to give him material to use. A learned man stuffed with wit is the most hopelessly helpless of mortals if he has not the power to use his accumulations in a creative manner. Probably one-half our educated men are untrained men. They can acquire only, but cannot express themselves. Such persons are largely to be set down to the column of losses in our social organism. It is often not a question of will not work, but cannot work. It is like a silkworm that should know how to eat, but not to spin; the term "book-worm" fairly designates such people. Ability to work in its best definition means power to apply the whole energy to a designated point, and waste nothing. Many men there have been, of great capabilities and zeal, who have expended their energies on energy alone—the children of their excessive labour being still born, and never seeing the light. Should not the child from very early years be specifically taught, not simply to know, but to do? Should not specific achievement be set before him, and he be gently but firmly trained to accomplish that, to perfect it? The art of music is ever a fine illustration of what sort of preparation a human being needs in order to fine doing. From early days the child must daily practice until a certain portion of doing passes over into unconscious action, and is automatic. The brain-worker can never do great things until much of his work is done unconsciously, or nearly so. But after that must be retained a power to apply.

However, it is a question whether any one ever accomplished much intellectually without a love for his work. If you do not enjoy the creative power of the creator or essayist, it is rarely possible to become efficient. It is possible that a few, by sheer force of will, have worked on to the end, and really done a great deal of building with their brains. Such cases are in the small minority. The tendency is to learn to love what we learn to do well. It is possible to find a grand delight in working with tools, so also with words, which are the tools of the brain. If this positive affection does not exist, and cannot be created, literary toil must be doubly wearing, as well as, in time, unendurable. Our first duty is to find that field of work in which we can delight; and if that be not attainable, if we do not turn with keen pleasure to the pen, it is clearly not wise for us to insist on being literary devotees. We have seen carpenters who petted their chisels, hammers and planes, who disliked to have others touch them, and to whom every shaving from a stick of pine was an object of beauty. Such men do fine work. It is a part of the world's art as much as the statues of sculptors. Work of all sorts, done lovingly, becomes art.

We are creating a certain national taste for brain work, which rises, at periods and places, almost to a passion. The question becomes pressingly important how to be able to acquire

most and to achieve most intellectally without loss physically. This must be considered in connection with the fact that the human race as a whole has, for long ages, steadily grown more brainy ; while our Saxon race has no emblem more descriptive than a quill. Still, after the severest drill, leading to easy and even largely automatic work, there is no wisdom in despising systems and methods. If the question is ever present, how shall I accomplish the very largest amount of brain work and come off sound in the end? the answer must involve a good many precautions. We are constantly confronted with the fact that hosts of our workers are breaking down. We are even alarmed lest it become a chronic national habit to fail of intellectual grip prematurely. The new generation rises neither to eminence in work, nor to independence in character. Sir Joshua Reynolds says : "Nothing is denied to well-directed labour, and nothing is attained without it ;" but he is careful not to say that labour of the brain or of the hands, purely as prodigious energy, ever accomplishes much of value. It is only well-directed toil that climbs the mountain.

Perhaps the first and most important rule in brain work, is that it alternate with social enjoyment. Writing or study is essentially solitary and individual in its nature. The student grows apart from his fellows and the results are most unfortunate. It matters little which is our favourite or wisest course, this general law holds good, that to make the most of our brains we must not run too steadily in a single groove. A fair division of time would give to literary work not over six hours a day for writing and three for reading. Probably most people will find it wisest to give one-third of time to sleep, one-third to their brain work and one-third to hand-work or employment.

Thought-saving is one rule with a person who desires to accumulate material and live out a large intellectual life. This is done in many ways. The best of all is to write a thought in quite deeply on the mind. This a good thinker learns to do. He repeats a good thought three or four times to himself in sharp, clear-cut words. For, say what we will, mind has a material basis. We must grave deeply what we wish to preserve. Superficial thinking is of two sorts, that which only touches the subject and that which only touches the mind. It is much like the work done with a pen on paper. The writing on the mind must be very clear and legible. Many find much benefit in walking about somewhat while thinking. Let the head catch clearly the idea from different standpoints physically. You will observe that if you move your head on waking from a vivid dream you lose instantly the whole ; but if, lying quite still, you recall and repeat the incidents, you have them fixed. It is equally useful to take a note of a passing thought. Writing it down renews and doubly vivifies it. Germans are said to think pen in hand. Too little of our university and school work is done by lectures. Our young folk have a poor habit of listening. Thoughts go out of one ear as fast as they go in at the other.

Memory saving is another important point. We try to make the brain do what it need not at all attend to. The sheet of paper is a modern invention to be a substitute for memorising. Whatever note can be stored in the note book the mind should not be troubled with. Do not to try to remember too much. It is the *results* of facts that should go into the mind. Nine-tenths of what people try to remember is of no importance as a part of mental furniture. Such matters may be of importance in our daily duties, or need to be easily recalled or referred to ; and the mass of such matters is vastly increasing. The true rule is to jot them down with a pen or pencil where they can be readily referred to. Save your mind all possible labour. There are many methods possible for the preservation of valuable thoughts as well as minutiæ of our labour. A habit of classification assists largely. When a thought appears in the mind let it be jotted down, without working it out fully, and then place it in a pigeon-hole with others of its own classification. For instance, we know a voluminous writer, who pins his walls all over with material for his work. These slips, clippings and notes are classified according to their nature—as a rule. There are subjects—a dozen or more at a time—accumulating material on the walls of his library. There are groups of historical, biological, psychical, and other slips. These are partly what he has caught from his own brain and partly has gathered from his reading. A newspaper often gives him a desirable item or illustration, which is cut out and the paper tossed aside.

Another rule for great achievement is that we must know how to get inspired, and how to take advantage of inspiration. The brain should not be driven or coaxed to work except when the individual is in the mood for it. There is no good work done when the brain does not really desire to work. To get into right conditions, of course, involves a sound bodily condition. A fevered body may fume for a while, but a cool after-study will be likely to draw the pen over all such writing. Dyspepsia is responsible for a vast amount of pessimistic work, that should be burned as fast as detected. Perhaps the best rule is to read all you can get on the subject first. Take notes as you read : and after that read your notes once over, and classify them. Lay them aside, jump on your horse, or your bicycle, and take an hour's exercise. Those notes must not be too fresh in your mind. They will enslave you, and prevent work. Now you have the subject fairly before you ; let your own mind loose at it, and pull it to pieces. If you are not a well-trained worker your first effort will give you nothing satisfactory, only patches and half a dozen starts. To-morrow morning sit down again. Don't try to put together yesterday's patches and pieces. Toss it all aside ; take hold of the subject fairly and squarely ; and ten to one you can handle it well.

But a well-trained brain gets to be full of inspirations. Bright thoughts dash in, take their places in groups and are anxious for the pen. Good habits will see that such inspirations are mostly taken care off. But this, above all, is to be borne in mind in order to accomplish much, do not mistake excitement for inspiration. The latter is always cool, calm, free, and seldom impassioned. When you work best is when you are most restful, and your nerves least excited, and your brain coolest. The result of such work is wholesome, and it is satisfactory.

SOME INTERESTING POINTS.

To a lunar observer the earth would appear to be about sixty-four times as large as the sun. From the earth the sun and moon appear to be about the same size. From the moon the sun would appear of the same size as from the earth, but as the earth has eight times the diameter of the moon, it would show sixty-four times as much surface as the moon now shows. This enormous disc of earth must be blue in colour to the lunar observer, because the earth's atmosphere is blue, and all things seen through it seem blue. Even interstellar space seems blue through this medium, and the illuminated parts of the moon cannot be distinguished from the space that abuts it. Bright, direct and reflected light, is not affected appreciably by its passage through our atmosphere ; therefore, stars, moonlight, and distant illuminations are not noticeably blue from that cause.

ARE WE KILLING THE MIND?

Probably no subject presents to the psychologist and the physiologist a greater number of unexplored regions than that of the senses and the organs of sense. As yet we do not know how many special senses we possess. To the traditional five are now added the muscular sense, about whose organs there is no little dispute; the temperature sense, including separate end-organs for sensations of heat and cold; and the now problematic sense of equilibrium, whose organs are thought to be the semicircular canals. Still less is known about the senses of animals. Some of these, as has been shown, are sensitive to colours, sounds, tastes, and odours to which the human sensorium does not react. Most interesting are the patient experiments of Sir John Lubbock, proving that the eyes of ants are sensitive to the ultra-violet rays of light. To them, therefore, even "white" light is not white. "The familiar world which surrounds us," says Lubbock, "may be a totally different place to other animals. To them it may be full of music which we cannot hear, of colour which we cannot see, of sensations which we cannot conceive." The presence of doubtful sense organs in animals. such as the muciferous canals of fishes, strikingly suggests the limitations of science; for we not only do not understand these organ, but perhaps never can understand them, as such sensations may be outside the range of our possible experience.

Returning to the human body, we find that very little has been said about the relation of the senses to each other, the order of their development in the evolution of the race, or the present tendency of their relative development. The theory proposed by Democritus, that all our senses have been evolved from the sense of touch, seems likely to be established by biological studies. But it may be more accurate to say that all the senses are specialised forms of a primordial sense, which may have been less like our sense of touch than that of sight. In this connection one recalls, and with somewhat less scepticism, certain recent experiments of the French investigators in abnormal psychology, showing that hypnotised subjects see and hear with their finger-tips. With the growth of intelligence, there has been a steadily increasing use of the two senses which gives us the finest discriminations and the widest knowledge of our surroundings, viz., the senses of sight and hearing. When each animal was obliged to search for and select his own food largely by smell and taste, the latter senses were no doubt the best developed. For tones, colours, and form these animals had little care. They thought, as far as they thought at all, in images of taste and smell, as we think in images of sight and hearing. Many animals now are smell-minded, and in thoughts and dreams of dogs and deer we may suppose that images of odours are as prominent as visual images are in our own. In man the crude organs of taste and smell have given place to the delicate eye and ear, both as avenues of knowledge and as sources of higher pleasures. What is true of taste and smell is true also of touch. Not confusing this with the muscular sense, the information we get from the sense of touch is small and the pleasure less. That this sense is capable of such remarkable improvment in the case of the blind is evidence only of its once greater use.

There is, in the nature of mental life, no reason why our images should be drawn so largely from the sense of sight. It is an accidental circumstance, due to the fact that we use the eye more than any of the other organs. The difference is both quantitative and qualitative. Our ears, to be sure, are never closed, but if we note the character of our auditory perceptions, we see that little attention or intelligence is needed in this direction. The significance of what we hear bears no comparison with the significance of what we see. In every-day life the principal office of the ear is the apprehension of spoken language. The limited and ever-repeated vocabularies of our verbal symbols call for little discriminative use. Thus far the ear is a drudge, carrying lifeless symbols to be interpreted. Even the spoken word is by many persons mentally turned immediately into the visual image, either of the thing represented or the printed or written word. On the other hand, some people, in reading, mentally represent the spoken word, but it is the motor representation of the *spoken* word, not a sensory image of its sound. The intelligent hearing of music forms a notable exception to the usual mechanical action of the ear, yet in the life of the average man the time given to music is comparatively insignificant.

The eye is not only more active, but its action is more intelligent. It brings us into closer relations with the outer world. It gives us not a time series of single elements, but a constantly changing space series of numerous elements. It is the constant and normal interpreter of our outer life. By its means we select our food, recognise our friends, detect our enemies, guide our steps, and co-ordinate the movements of our arms and hands. In all these movements our actions become automatic, but still always need some assistance from the higher senses, and the sense used in almost all cases is the sense of sight. For instance, with closed eyes we can write, but imperfectly. A practised musician may play with closed eyes, but commonly, even in this art pertaining to the ear, the eye is busy, glancing at the keys and following intently the printed score. So far has our eye-mindedness gone that we use the word "see" not only for purely intellectual perception, but even for perception by the other senses. We say that we *see* the fallacy of an argument, or we *see* that the paper is smooth, or the orange sweet, or even that the piano is out of tune, when we mean that we understand, or feel or taste or hear.

Now, in the use and relative importance of the two higher senses there has been a marked change even in historic times. It is possible, indeed, to trace the evolution of the eye during the last two thousand years, and to discover some of the causes producing the change. The ancient Greeks, for example, were ear-minded. By this is not meant that the sense of hearing was at that time absolutely more prominent than the sense of sight, but relatively so. Notice, then, how the Greeks used the ear, with its complementary organ, the tongue, while we use the eye and the hand. They were a conversing people; we are a writing and reading people. With them poetry was sung or recited; with us it is read. They conducted polities in the Agora; we in the newspaper. Success in political affairs depended with them largely upon oratory; with us but slightly. The instrument of philosophy and discussion was with them conversation; with us it is the newspaper. With them music was the most prominent branch in popular education; with us it is least so. Although the principle of Greek education was harmony of all the physical and mental powers, we have only to glance at the educational system at Athens to see the comparative unimportance of eye education.

If we seek the causes of our prevailing and increasing eye-mindedness, we shall find them chiefly in the invention and rapid extension of printing, engraving, and photography. These are the arts that have drawn so heavily upon our visual resources and made it so easy to dispense with the ear and the memory. The increasing time given to reading and writing, compared with the time given to listening and speaking, is apparent to everybody. The present generation is a book-and-newspaper-reading generation. We get our politics from the daily paper, our art from the magazine, our science from the text-book, our amusement from the novel, our gossip from

the biography, our facts from the cyclopædia. We speak of the man of education as the "well-read" man. He reads, of course, extensively in some special subject connected with his work or profession. As a foundation for this, however, he has read some standard works in mathematics, or philosophy, or physical science, or history, or philology. New books, reviews, and articles, relating to his profession or specialty he must, of course, be constantly reading. Besides these he must at least glance over some of the leading articles in the best of the hundreds of weekly, monthly, and quarterly periodicals, magazines, and reviews. Then there is his private correspondence with daily letters to read and write. With all this mass of reading, however, he might not become quite a reading machine, and might find a little time for the use and cultivation of other bodily organs than the eye, were it not for the daily paper. The tireless steam press ruthlessly grinding out some thousand large pages per hour has become a kind of tyrant rather than a servant of man. By what curious perversion of modern conscience have we learned to believe it our daily duty to read that A. B. robbed a bank and that C. D. wrote a book, that E. F. married and that G.H. killed a wife, that the weather is colder here and warmer there? But if we have learned to skip the crimes and casualties, we consider it our bounden duty daily to scan at least the field of politics. What one reads others must write and print. Day and night, therefore, editors, reporters, correspondents, and printers, are busy with eye and hand.

In our present enthusiastic devotion to the eye it is not alone the symmetry of the mind that is threatened nor the voice arts alone that will suffer. It may be that we are neglecting that which is in itself one of the richest sources of good. It has not yet been shown that the world of form is more worthy of our cultivation than the world of sound.

EYES OF DIFFERENT PEOPLE.

Eyes have always been regarded as a sure tribal characteristic. Tacitus, for example, describes the Germans as "fierce, with blue eyes and red hair." The Celts are mentioned as being swarthy skinned and black eyed; the Gauls are red haired and light eyed, while the Nubians, th Turks, the Egyptians, and the Italians have always been spoken of as "the dark eyed races." These peculiarities have not changed. Even to-day the people of the temperate zones have generally light coloured eyes, while those of the torrid and frigid zones are usually dark, or even black. Of the races in particular, the only one that can be said to be "light eyed" is the Caucasian, and even in this race, the eyes are by no means uniform in point of colour. The whole period of human history goes to prove that the light haired, blue eyed races are capable of the highest degree of civilisation, but it does not by any means follow that the highest degree of civilisation is confined to people of blonde complexion. There was a time when a blue eyed person was rarely seen, and to day seven-eighths of the world's inhabitants have dark eyes. Lavater, when discussing the eye as a feature in national physiognomy, gave the following as the results of his observations: The Italians have small eyes; the Germans, light-coloured eyes surrounded by many wrinkles; the English, strong, open, steadfast eyes; and the Swiss, eyes that are very dull looking."

A German professor claims to have discovered the bacteria which causes baldness by destroying the roots of the hair.

WILL THE SUN CONSUME US?

While there can be no question that suns have a life-history, a beginning and an end marking the termini of a regular process of development, and that consequently the stars that we see differ in age, still it is not yet possible to say with absolute certainty at just what point in the scale of solar development our sun, or any other particular star, has arrived. The question whether a sun is still approaching the climax of its radiative energy, or has passed that point and is descending the scale, is an important one as regards the ultimate destiny of inhabited worlds revolving around it. It is upon the revelations of the spectroscope, assisted by photography, that we must depend for the advance of our knowledge of the condition of the various orders of suns. It is apparent, that progress by our sun in any direction would, in the end, prove exceedingly uncomfortable if not fatal to the inhabitants of the earth. By the subsidence of the vapours of metals that now stripe the solar spectrum with their absorption we should be, in effect, removed into the presence of a star Sirius whose fierce beams would smite the living world with death. On the other hand, let the sun sink into the condition of a similar star enveloped in a metallic vapour, and become variable in its outpourings, and our condition would be even worse. If it be thought that a planet whose orbit is as eccentric as that of Mercury is hardly habitable because the solar heat it receives varies so greatly in intensity, what is to be said of the condition of a planet subjected to the terrific mutations of Eta Argus, a star that in 1843 rivalled Sirius itself in brilliancy, and that since 1868 has been invisible to the naked eye, and has sunk as low as the eighth magnitude? Some of the comets undergo far less severe alternations than such a world must endure. In either direction, then, the prospect of solar evolution seems unfavourable, considered from the planetary standpoint. What the planet most wants is an unchanging and unchangeable sun. But this is impossible. In the presence of eternity a sun, whether it grows hot or grows cold, white or red, with age, is a thing as essentially evanescent as a zephyr.

But we cannot rest with the assumption that, since the sun is evidently no Mira, blowing alternately hot and cold, and no Sirius, shining with seventy times the light of our sun, therefore it is practically an unchanging radiator which for an indefinite period will continue to cause the earth to bloom in the beneficent effulgence of its life-inspiring rays. A sun may affect the welfare of its planets either through the gradual mutations which it undergoes in the course of its evolution, or through the more rapid and violent changes that characterise the stars that are ranked as variable. There is reason to suspect, however, that the majority of all the stars are variable to a slight degree, and evidence of variability in the case of the sun is furnished by the phenomena of sun-spots. A spectator, viewing the sun from a distant point in space, would perceive that its brilliancy was slightly increased once in about every eleven years. These accessions of light should correspond, not with the periods of fewest spots, but with those of most spots, because the energy of the sun's radiation is greatest during the spot maxima. At present a sun-spot maximum is approaching, and since last winter the face of the sun has frequently exhibited startling indications of the tremendous disturbances now affecting the solar globe. Our imaginary observer in space would probably behold at the present time a very slight increase in the sun's brilliancy, and this increase may go on for three or four years to come. While we, dwelling upon a globe that is bathed in the sun's rays,

may be unable to pereeive these variations direetly, yet their effects have long been recognised by the changes that they produce in terrestrial magnetism. It is also highly probable that a perceptible influence upon the weather is exereised by variations in solar radiation eorresponding with the presenee or absence of sun-spots. So far as trustworthy observations have gone, it appears that the temperature upon the earth is slightly lower when sun-spots are most numerous. This is exaetly the opposite to the effeet that might have been antici-pated ; but as the observations from whieh the inferenee is derived are confined to India, it seems probable that the low-ering of temperature, while primarily brought about by the condition of the sun, is directly due to the aetion of loeal eauses, and that in other parts of the earth a simultaneous inerease of heat may be experienced. A very great inerease of solar radiation, however, could not be thus masked in its effects upon the earth.

Although during the historical period there has probably been no sufficient variation in the activity of the sun to pro-duce very serious terrestrial results, yet it is known that the sun-spot cycle is subject to considerable variations, both as regards the length of the periods and the intensity of the forees concerned in the disturbance. The latest maximum of sun-spots in 1883—84 was a couple of years overdue. What peculiarities may mark the maximum now approaching time alone can reveal. But, at any rate, the known irregularities of the sun suggest a striking resemblance to what we see in some of the variable stars ; and it is highly probable that the changes of the latter, exeept in certain cases where other more satisfactory eauses have been inferred, are due to phenomena resembling sun-spots, if not in fact directly analogous to them. Is sun-spottedness, then, a progressive condition ; and will our sun in time become, through this cause, variable to the extent shown by many of its eompeers in the heavens ?

It is true on aecount of the remoteness of any calamitous effects resulting from such gradual changes in the sun's eon-dition we can afford to regard them with indifferenee, so far as the welfare of our race for many thousands of years is concerned ; but when we rise to a higher point of view, and put aside merely human measures of time, the question becomes one of deep interest, since it involves the probable ultimate fate of our planet as the scene of development and achievements of intelligent ereatures. Will the earth become a desert like its companion the moon through the exhaustion of its vital forees and the disappearance of its air and water while the sun yet shines upon it with unfailing splendour ; or will the end of terrestrial life be brought about by the agency of the sun itself, either through the failure of the solar ener-gies, or through an overwhelming outburst of them ? These questions are not the less interesting, and not the less eertain to obtrude themselves, because it is at present impossible for us to answer them. They have also a bearing upon the geo-logical life record of the globe. Already, under the enormous demands for time made by the evolutionary doetrine, geology is asking for far longer periods of stability in the light and heat supplies of the sun than astronomy, also supporting itself upon the prineiples of evolution, is able to grant. But if the sun has emerged from the stage of a third or fourth type star, and by gradual elimination of its obstructive envelope has arrived at that point of eomparative regularity of radiation in which we behold it, the time dur-ing which it can have maintained the earth in a habitable eondition is proportionally shortened, for we cannot suppose that animal and vegetable life eould be developed under the dominion of a distinctively variable star. The assumption is here made, of eourse, that a variable star is really a sun and not a cloud of meteorites in collision, or a partially con-densed nebula, and that its planets, if it is ever to have any, have already been formed. Progress in the other direction would seem to supply longer periods of nnvarying solar radiation for the evolution of planetary life, since a sun developing in that way would beeome a stable radiator sooner than if it had first to free itself from a sheathing of absorbing vapours ereated, it may be, by its own action at a eertain stage of its eareer rather than left behind as a subsid-ing remnant of the original nebula.

We have remarked that, so far as the reeords of human history inform ns, the emission of light and heat by the sun has never seriously varied. Yet it has been thonght, although the evidence is not clear, that there are geolo ieal indications of eonsiderable variations in the amount of solar radiation in past time, and the famous myth of Phaeton driving the chariot of the sun and getting so far out of his road that he endangered the earth and made it smoke with unwonted heat, has often been referred to as a possible tradition of some ex-traordinary outburst of solar heat within the period of man's existenee. The variable character of sun-spot phenomena certainly does not contradiet that supposition. The margin of existence is so narrow for many forms of life that no very great ehange would be required to eause a disaster. Still, notwithstanding the vagaries of sun-spots, and the apparent analogy between the sun and the variable stars, it would not do to assume that the earth is at present in any danger from a changing mood in its great governor and benefactor. So far as positive records serve as an indication of the future, there is every reason to believe that the sun will long eontinue in its present eondition, and that astronomers a million years hence, if some cataclysm arising from ulterior causes does not intervene, may still be found studying the sun, having probably by that time ascer-tained whether it is getting hotter or colder. But it would not be safe to assume that any astronomers will be left npon the earth five million years hence.

A BOILING LAKE.

THERE is a lake of boiling water in the Island of Dominica, lying in the mountains behind Roseau, and in the valleys surrounding it are many solfataras, or volcanie sulphur vents. In faet, the boiling lake is little better than a erater filled with scalding water, constantly fed by mountain streams, and through which the pent-up gases find vent and are rejeeted.

The temperature of the wat r on the margins of the lake range from 180 deg. to 190 deg. Fahrenheit. In the middle, exactly over the gas vents, it is believed to be about 300 deg. Where this active action takes place the water is said to rise two, three, or even four feet above the general surface level of the lake, the cone often divid-ing so that the orifices through which the gas escapes are legion in number. This violent disturbance over the gas jets, causes a violent action over the whole surfaee of the lake, and though the cones appear to be special vents, the sulphurous vapours rise with equal density over its entire surface.

Contrary to what one would suppose, there seems to be in no case violent action of the escaping gases, such as explos-ions or detonations. The water is of a dark gray colour, and, having been boiled over and over for thousands of years, has beeome thick and slimy with sulphur. As the inlets to the lake are rapidly closing, it is believed that it will soon assume the eharacter of a geyser or sulphurous crater.

SUN DIALS.

Floral sun dials are a great fad with our transatlantic cousins, and one of these on a big scale is now in course of erection in Golden Gate Park. It will be a veritable mammoth dial. The gnomon or style of the great time-piece, now nearly complete, is twenty-four feet high, and the dial sixty feet in diameter. When finished the correct time of day will be readable at a distance of a mile.

It is strange in this wonderful age of timepieces that we should have recourse to the primitive time measurers of our forefathers, although the object is, of course, decoration rather than utility. It is somewhat interesting to look back not only at the gradual evolution of the primal clock, to the wonderful chronometer of to-day, but to observe the early efforts of man to measure the time by any device. The first sun dial that was set up in Rome was erected by Papyrius Cursor, about the year of the city 447; for Pliny says there was no mention in any account of time, but of the sun's setting and rising. This dial was set up in the temple of Quirinus, but it was not accurate. About thirty years after this, M. Valerius Messala, says Varro, being consul, brought out of Sicily, from the taking of Catania, another dial, which he set up on a pillar near the rostrum; but not being made for that particular latitude, it could not go true. Nevertheless they made use of it for eleven years, and then Marcius Phillippus, who was censor with Lucius Paulus, set up another that was more exact. The Greeks also were a long time without clocks and sun dials. Some ascribe the invention of sun dials to Anaximines Miletius and others to Thales. There are many kinds of dials mentioned by Vitruvius; as one invented by Berosus the Chaldean, which was on a reclining plain, parallel almost to the equinoctial; there was a half circle upon it, and thence it was called hemicyclus. Aristarchus Samius found out the hemisphere dial. And there were some spherical ones with a needle for a gnomon. The discus of Aristarchus was an horizontal dial, with its limb raised up all round to prevent the shadow from extending itself too far.

Sir William Thomson estimates that in a cubic inch of any gas there exists 100,000,000,000,000,000,000,000 minute molecules, in each of which there are several atoms moving among themselves at the rate of seventy miles per minute.

PERPETUAL PRIZE COMPETITION.

Every reader of SCIENCE SIFTINGS may obtain a prize by following out these instructions:

Cut off the Coupon on the cover of this Paper, and beg your friends' Coupons, and then paste them neatly on sheets of foolscap, each Coupon separately numbered. Send these to the Publishers of SCIENCE SIFTINGS, 78, Fleet-street, E.C.

The largest number of Coupons during the present quarter will receive an award of

Ten Guineas.

These Coupons must be sent in not later than December 31, and the award will be published within three weeks of that date.

With the issue of January 5 (which will be dated January 9) a fresh competition of an identical nature will be started for Coupons commencing with No. 12. Any Coupon not beginning with this number will be ineligible for the second

Ten Guinea

prize; but, as these competitions will continue to the end of our first year, we have determined to award consolation prizes amounting to

One Hundred Guineas,

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but this prize will not be awarded to anyone who has received the

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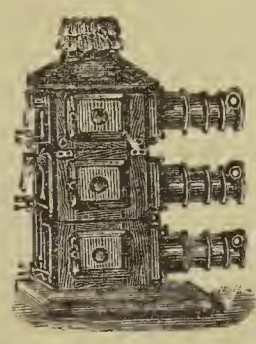

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LONDON : SATURDAY, NOVEMBER 21, 1891.

SCIENCE NEWS AND NOTES.

After Thousands of Years

of peaee, it appears as if a perfect raid were about to be made on the waterfalls of the world for the purpose of utilising their motive power. Of eourse, we do not forget the old days of turbines and the present-day mill-wheels, but it appears now, for the first time in the history of the world, as if the full value were to be extracted from these natural resourees. The impetus to this rush was the great suceess of the 300 horse-power lately received at Frankfort-on-the-Maine, from the famous falls of the head waters of the Rhine in Switzerland. This has stimulated all the industrial centres in Switzerland where they have plenty of water power, thus far utterly wasted for eenturies, and in a eountry where they have no coal and only a limited supply of any kind of fuel, it will easily be understood how much this application of water power may do for industry.

The Swiss Mountain Streams

possess advantages that are not shared by those in many other eountries. These streams never fail, as in the hot season they are chiefly fed by the melting of the snow between the tops of the Alps, and by the eontinual deseent of the glaciers in the valleys. It appears that all over Germany the public attention is called to this waste of useful power, which thus far has been going on for thousands of years, and appears at last to have become useful for the benefit of man, by the agency of that great and mighty power which he has sueeeeded in bridling and harnessing as his servant.

Amputated Limbs,

we had always believed, are, after separation from the body, no longer subject to the ills to whieh flesh is heir. We were of opinion that after amputation the nerves died and the limbs decomposed, but a eorrespondent tells us a very different tale, and as he himself is a one-armed man, his version of the phenomenon he describes may be relied on. Aceording to this authority, the nervous sympathy between the individual and the limb does not eease on amputation.

Any Man who has Lost a Limb,

if we may believe our authority, will tell you that the fingers and toes on the missing members sometimes get as cold as any other part of his anatomy. One man who was shot in the arm in battle was taken to a farm house near by, where the doctors performed the amputation. The man of the house put the arm in a box, nailed it up, and buried it in an orchard. The next day the wounded soldier eomplained that his arm troubled him. It was all doubled up, he said, and the fingers felt eramped. He grumbled for two or three days without anybody paying mueh attention to him, for the house was full of wounded men, and the doetors were too busy to spare the time to look after an amputated arm, but finally the man beeame so troublesome that they eoneluded to try a little experiment. So without telling him what they were going to do, they went to the orehard, dug up the arm, took it out of the original box, laid it straight, plaeed the fingers in a natural position, wrapped it in eotton wool, put it in a longer box, and buried it again. The man declared he felt his arm relieved at the very moment when they were straightening the missing member, and never complained again. They told him nothing of what they had done until he was about to be diseharged from the hospital, and then gave him the story in full.

Broken Hearts

are responsible for volume upon volume of fiction, but we have only heard of one really authentie ease where the heart has been literally broken. As the event that led up to the disaster is somewhat interesting, we give the details. The patient was a young Portuguese, whose wife had been slain by a former suitor. The husband was a robust man, but after his wife had been killed, he sickened, although apparently there was nothing the matter with him. Medicine did him no good, and he finally died. At the autopsy a searching investigation of his heart was made. Direetly aeross it from the main feeder was a line, or what appeared to be a line, whieh, when the surgeon dissected the organ, was seen

extending clear through it. The body was searched throughout for the origin of such an abrasion, but none could be found. It was there, to be sure, but how it came was not revealed, although for five days the surgeon studied the matter. The immediate cause of death was consumption. The brain was in normal condition but the lungs badly diseased. When a person dies of grief—and very, very few do so—the brain, rather than the organ of sentiment, suffers most, and an examination of the heart reveals no distinct traces of the ailment. We did not believe that there was such a thing as a person dying of a broken heart until three years ago, when the case we have quoted actually occurred in a Madrid hospital.

November Fogs

have again given us a taste of their unpleasant effects. If, however, we may rely on Dr. W. J. Russell, F.R.S., they are not always as unhealthy as we have been led to believe. Dr. Russell has made a close examination of the Registrar-General's returns, comparing the rate of mortality with the temperature and the amount of fog. The great fact demonstrated by this investigation is that most fogs occur when there is a great fall of temperature, and this is clearly followed after a few days by a great increase of death rate, but how much of this is due to fog and how much to fall of temperature is difficult to determine. We have, however, evidence that when fogs occur without fall of temperature they are not followed by marked increase of death rate. On four occasions within the last two years there was dense fog with temperature above the average, and on these occasions there was no increase in the death rate, which was, indeed, below the average. All the other fogs were accompanied by depression of temperature, and always followed by increase of death rate. Many suffer from fogs, and they are no doubt unwholesome, but much less so than is generally supposed.

London's Soot

is another burning—we should say unburnt—question of the day, of which we are reminded by our paragraph on fog. As we have said on previous occasions, we can expect little abatement of the smoke nuisance until such advances are made in electric lighting and heating as will enable us to do without the consumption of fuel in our great cities and towns, where the density of the air and the crowded buildings will not permit the dispersal of the atmospheric impurities. The amount of carbonaceous and other particles deposited upon glass houses is a good indication of what the London atmosphere contains, and in many places it is only possible to procure a due admission of light to the plants by frequently washing the glass roofs. In one establishment, according to a contemporary, two tanks constructed to collect the rain from a house completed a few years since were cleared out, and no less than ten barrow loads of sooty matter were removed, all of which must have been conveyed into the tanks from the glass. One scientific man has been engaged in computing the amount of soot deposited from London air, and arrived at the following conclusions. He collected the smoke deposited on a patch of snow in Canonbury one square link (about 8 inches) in extent, and obtained from it two grains of soot. As London covers 110 square miles, this would give us for the whole area 1,000 tons. As the quantity measured fell in 10 days, a month's allowance would need 1,000 horses to cart it off, and these stretched in a line would extend four miles.

The Value of the Tongue

as a respirator is advanced by a correspondent writing to the *Lancet*. According to this authority, nature has provided each of us with the best respirator always at hand in the tongue. The mode of procedure is to never quite close the mouth, but keep the lips a trifle parted, at the same time curl up the tongue towards the roof of the mouth until the tip reaches as far back as the soft palate, and gently press the arched under surface of the tongue in some degree against the hard palate (a little practice soon makes this easy to do). The cold air then, as it enters the mouth, strikes against the under surface of the tongue, as well as the floor and sides of the mouth, and is made to pass in a somewhat circuitous manner between the sides of the tongue and the buccal (cheek) mucus membrane of the pharynx (the back of the mouth), being thereby warmed in its course, so that by the time its reaches the larynx it is nicely rid of chill, and does not excite cough and catarrh. At the same time a certain quantity of air, of course, finds its way through the nasal passages to the chest, and it is obvious that a larger quantity of cold air can be effectually warmed by this method of procedure than by relying on either the nose or mouth alone. That the large blood supply of the tongue renders this organ an excellent air warmer must be obvious to all.

A Chinese Origin

has been given to many of our modern inventions, and our friends of the Celestial Empire consider that every recent advance in invention and discovery really belongs to their own country, at the period the people sat at the feet of that reverend philosopher, Confucius. It has frequently been asserted that the Chinese invented the telephone, but no serious attempt has ever been made to prove that such is the case. There is little doubt that in certain religious temples in the East there have existed for ages acoustic telephones in some form or other, the true nature of which was known only to the priests, but there is no evidence whatever to show that the electric telephone was known in China before the time of Bell.

In the Case of the Phonograph

there is not even that semblance of Chinese origin which surrounds the telephone, and it stands forth almost unique as the one grand achievement which everyone concedes to be Edison's. Far be it from us to detract from the glory of the great Edison, but if you do not admit that Addison in the seventeenth century described the working of the modern phonograph when he wrote "Frozen Words," it is because you have never read the *Spectator*, or never have toiled with the sonorous wax.

Addison

describes the plight of a ship's crew which put into Nova Zembla, where the intense cold of that latitude froze their words and preserved them until the thaw came, when, says Addison, "Our cabin was immediately filled with a dry, clattering sound, which I afterwards found to be the crackling of consonants that broke above our heads, and were often mixed with a gentle hissing that I imputed to the letter S, which occurs so frequently in the English tongue. This was soon followed by syllables and short words, and at length by entire sentences, that melted sooner or later, as they were more or less congealed; so that we now heard everything that had been spoken during the whole three weeks." As though to make the realism complete, and to exactly describe the behaviour of the modern wonder machine, Addison puts in this clincher: "Presently we

heard a volley of oaths and curses, uttered in a very hoarse voice, which I knew belonged to the boatswain, who was a very choleric fellow, and had been swearing and cursing at me when he thought I could not hear."

The Palm for the Invention

of the phonograph may now undoubtedly be awarded to Addison, and this will no doubt please those friends of Mr. Edison whose archaic researches have been so fruitful in anticipations, and who are so anxious to free him from the stigma of ever having invented anything. We, for our part, do not go as far as this, although our recent strictures referring to Mr. Edison as an adapter of discoveries rather than as a discoverer or inventor, will no doubt be remembered. It is strange, however, that the great poet and essayist, writing 200 years ago, should have described an experience with which everyone who has used a phonograph is but too familiar. For it is now physically possible, by using what is known as a water jet transmitter, to freeze a wavy line upon glass or other suitable substance which could actually be made to reproduce Addison's frozen words.

The Wonderful Possibilities

of the phonograph have not yet entered into the mind of even Mr. Edison himself. Its use, in connection with the telephone as a repeater and as a recorder of messages, both at the central office and at the sub-station in the absence of the subscriber, has already been discussed, and the possibility of accomplishing ocean telephony by means of a slow moving cylinder revolving at a speed having the proper relation to the time element of the cable, has been suggested. In these and many other ways the phonograph is destined to work a revolution in telephony.

Electricity

is, of course, not essential to the phonograph. The necessity of using the electric motor for revolving the cylinder has frequently been deplored, but the phonograph of the future, the perfected machine, depend upon it, will be an electrical apparatus. The diaphragm will not be mechanically operated by the record, but will be vibrated by the varying pull of an electric or magnetic field, probably the latter. It is only in this way that the theoretically perfect sound curves can be reproduced free from mutilation and the constant grind which must be present as long as the stylus is permitted to bear upon the cylinder. Humanity and civilisation suffer for every day that the perfection of the phonograph is delayed. The phonographic book which is sure to come with the improved apparatus, to say nothing of the delights of listening to the world's greatest singers and musicians, would be such a boon to the blind and to invalids that there is no better opportunity for the rich philanthropist of to-day to prove his title to the name than to establish "The Society for the Perfection of the Phonograph." There are other and still more wonderful powers stored up in the little cylinder of wax.

Silver Thaw

is a name applied to a winter phenomenon of frequent occurrence at Ben Nevis Observatory. It consists of rain falling when the air is below freezing point and congealing whenever it reaches the ground. Of course this points to an inversion of the temperature, which is lower on the mountain top than at greater heights, and, being largely associated with a cyclonic distribution of pressure, it is of considerable "forecasting" value.

The Small Brain of a Woman,

as compared to that of man, is often the assigned cause for the alleged intellectual inferiority of the weaker sex. We may as well set this matter right once and for all, since nothing could be more absurd than this comparative theory. One of the least intelligent monkeys has a brain larger in proportion than a man's. The degree of mental power depends upon the convolutions. Examine the brain of a hen, which is not rated as a genius among animals, and you will find that its surface is nearly smooth, while that of a human being looks like so much maccaroni twisted in and out. Depend upon it then, size has nothing to do with the matter.

A Typewriting Machine

specially intended for the use of the blind, has recently been constructed. It is a most beneficent invention and can be easily and effectively used by the sightless. In constructing the machine the greatest care has been taken to provide means of insuring accuracy of manipulation, and after a little practice, it is confidently stated, those who are deprived of sight can work the machine with as much certainty as those who can check with their eyes the work of their fingers.

A Shower of Fishes

is one of those remarkable phenomena which it is said has never been satisfactorily explained by science. This is, perhaps, incorrect. Several causes have been suggested. Might it not very probably be that fish and frogs which fall apparently from the skies are really bred there? Water fowl, it is known, very frequently carry eggs of fish to great distances, having swallowed them, and in their flight disgorging the same unharmed where they can and do fructify and mature in water over which these birds pass. The eggs of many old fish are very glutinous and readily adhere to substances brought in contact with them during particular times of their incubation. It is very probable that these birds convey ova upon their wings as well as in their crops, and when flying at great heights the ova, becoming detached from the wings, may remain suspended in the moist atmosphere, which is quite possible under certain conditions of atmospherical pressure, and that when under development they become too heavy and naturally fall to the earth as frequently witnessed. When we consider the heavy scoriæ from volcanoes, which is upheld for months at similar altitudes, we can not but give some credence to such a theory as the above. Could not some of your readers enlighten us still more upon a topic which must be of interest to all.

Photography in Colours

is severely questioned as a practical art, notwithstanding the reports circulated periodically to the effect that tints have been reproduced with permanence by the camera. Those who are competent to question the possibility of colour photography, do so on grounds that there is no such thing as an effect produced by certain light rays upon the eye. The most beautiful iridescent mother-of-pearl, showing every hue of the rainbow, has no colour of its own. They are made solely by the wave-like surface of the material, which decomposes the light as a prism does. Parallel lines scratched close together—a thousand or more to an inch—on ordinary glass, will obtain the same result. Indeed, it is not correct to say that anything is red, or blue, or green in itself, it is simply that the surfaces of the objects in question are respectively of materials so constituted as to reflect rays in certain wave lengths. Upon the length of the light-

waves depend the tints. The most distinguished authority on this subject that ever lived, Prof. Von Helmholtz, is of the opinion that the eye actually receives but three primary colour impressions, which by an ingenious internal arrangement of the organ are differentiated into a multitude of variations. There is no possibility of reducing such phenomena to a mechanical basis, and therefore colour photography will never become a realised fact.

Amidotetramethyltetramidoditolylphenylmethane

is not the title of a new popular puzzle or game, but a preparation used in the production of cartridges for the Winchester repeating rifle. We can quite understand the deadly effects of a cartridge that requires such words as this to express its component parts.

The Sound of the Aurora

has puzzled many of the most expert scientists. Mr. William Ogilvie, in dealiug with the question whether there is any audible sound, gives the result of a very interesting experiment, proving that the question may be answered in the affirmative, although he personally has often listened when there was a very brilliant display, and despite the profound stillness which is favourable to hearing the sound, if any sound occurs, he cannot say that he ever even fancied that he heard anything. Mr. Ogilvie has met people who said they could hear a slight rustling sound whenever the aurora made a sudden rush. One man was so positive of this that when there was an unusually brilliant and extensive display, he took him beyond all noise of the camp, blindfolded him, and told him to speak if he heard anything. At nearly every brilliant rush of the auroral light the man exclaimed, "Don't you hear it?" All the time Mr. Ogilvie was unconscious of any sensation of sound.

The Old Copy-book Line

"Paper is made of rags," is rapidly becoming obsolete, in fact. Formerly all paper was made out of rags, worn-out clothing, and the like, and when such material as straw was first introduced there was a general outcry. Now, however, comparatively little paper is made out of rags exclusively, a fact which is fortunate, as the quantity of paper now used is so great that there would not be enough worn-out clothing or shoddy to supply the demand. A remarkable fact is that while paper is being used for dozens of purposes formerly monopolised by wood or even a harder material, such as wheels, boxes, barrels, tubs, pails, and so forth, wood is rapidly driving other ingredients to the wall in the manufacture of nearly all the cheaper grades of paper. Wood pulp is made by a comparatively lengthy process, but by taking the mills to river banks where there is raw material and water power on hand, it can be produced at less than half the price formerly charged. This, more than anything else, is the cause of the cheapness of grades of paper below the average quality.

The Fecundity of Fish

is set forth in a most interesting report of the Fisheries Board of Scotland. The ling produces a greater number of eggs than any other fish; 20,000,000 to 30,000,000 may be considered an ordinary average among medium-sized and large specimens. The cod produces from two or three to seven or eight millions; the haddock from two or three hundred thousand to nearly a million; the saithe from four or five to seven or eight millions; the torsk, or tusk, from about one to two or three millions. In the herring the number ranges from about 20,000,000 to about 50,000,000, the average for 16 specimens examined being over 30,000,000, showing a considerably greater fecundity than has been generally supposed. Among flat fishes, the most fertile is the turbot, with from three or four to nine or ten million eggs, and the least so the long rough dab, which produces from about 30,000 to 60,000. In proportion to its size, the flounder produces more eggs than any other fish, the number ranging from over 500,000 to about 1,600,000. The common or English sole is also very fertile.

An Interesting Theory

respecting the particles of dust floating in a sunbeam was advanced last week by a competitor for "The Prize Science Sifting." Mr. Archibald Esau now questions whether the fact of the particles of dust not touching one another while floating in the air may not be accounted for as follows:— Being very light the slightest breath of air moves them. When, therefore, one particle is moving towards another, a certain amount of air has to be first displaced; this, of course, would create an infinitesimal draught in the direction of the latter particle, and so move it aside, thus avoiding contact. The fact of a tiny cushion of air having first to be moved before a collision can take place acts equally in every direction, and, Mr. Esau thinks, "supplies the principle your correspondent thinks is involved."

Bees

or some of the family may one day be substituted by besieged cities for carrier pigeons, if the experiments now being tried by M. Teynac, of the Gironde, should prove successful. Up to the present the idea does not strike one as being very practical, except from the point of view of interest. Numerous experiments, not altogether new, have established the fact irrefutably that if a swarm of bees be inclosed in a bag and carried to a distance of less than two or three miles from the hive, and the bag then be opened, the bees, after whirling around for a few instants, will quickly take flight in the direction of the hive with that certainty of instinct with which nature seems to have endowed all animals to a greater or less degree. The most active ones will cover the distance within a length of time varying between twenty and twenty-five minutes, which corresponds to a mean speed of seven miles per hour. It was starting from this fact that M. Teynac conceived the idea of utilising the instinct that leads the bee to its home for making a messenger of it. A difficulty, however, lies in the small extent of the field of operations of the same swarm, and this would, for transmission to a long distance, necessitate a multitude of intermediate stations two or three miles apart. It is true that the establishment of such stations is neither difficult nor costly, since there is no need, as with the other messengers, to trouble one's self with the question of feeding, but, on the contrary, each station would be a source of revenue to its guardian. But, in most cases, for a besieged city, the establishment of a station at a distance of two miles is so evident an impossibility that it is not necessary to dwell upon this point. Moreover, relays so close together would occasion great losses of time. It remains to be seen whether in the immense family of hymenoptera there may not be found a messenger which, through patient training and proper selection, might be able to travel greater distances. It is towards this point that the researches of M. Teynac are being directed, and he is now experimenting with the *Bombus hortorum*, domesticated by him.

THE PRIZE SCIENCE SIFTING.

One Guinea will be paid each week to the contributor of the most interesting or curious Science paragraph.

The paragraph must not exceed 200 words, and need not be original, but in this case, the source from whence it is copied must be given. All paragraphs must reach us on Monday, and be marked "Prize Science Sifting" on the envelope unless a postcard be used. Only one paragraph may be sent in by each competitor.

The Editor reserves the right of publishing any paragraphs sent in.

We have awarded the prize of One Guinea to Mr. H. MUNSHALL, Central Institute, S.W., for the leading "Science Sifting." The other siftings published all deserve honourable mention.

The Size of Molecules.

ALL matter, according to the atomic theory, consists of an immense number of very minute pieces of matter known as atoms which are supposed to be indivisible. Sir William Thomson has, by experiment and calculation, estimated the distance between the centres of contiguous molecules as between one billionth and one five-millionth of a centimetre, or, to make it more popular, if we imagine a drop of water magnified to the size of the earth, a molecule would be between the size of a heap of small shot and a heap of cricket balls!

A Curious Parasite.

THE tiger suffers from a curious parasite. The hairy part of its feet contains a parasite scarcely visible to the naked eye, yet each little insect is a perfect counterpart of the tiger—head, ears, jaw, legs, claws, body, tail, *all are there*.

Henry Abell, 4, *Trinity-grove, Greenwich, S.E.*

Advantage of Activity.

SUPPOSE two men of equal weight to ascend the same stair, one of whom takes only a minute to reach the top, and the other takes two minutes. It will cost the first little more than one-fourth part of the fatigue which it costs the second, because the exhaustion is in proportion to the time during which the muscles are in action. The quick mover may have exerted, perhaps, one-twentieth more force in the first instance to give his body the greater velocity, which was afterwards continued, but the slow supported his load four times as long.

C. W. Moor, 2, *Oakdale-terrace, London-road, Sittingbourne.*

The Whole of Science.

THERE are two things, and only two things, in the the universe—*Ether* and *Energy*. Ether exists in all space and electrical, magnetic, and optical phenomena are due to its action. Ether in a state of vortex motion (like the smoke rings made by some smokers) constitutes *atoms*, the size and velocity of rotation of these vortex rings deciding the properties of the atoms. About 170 kinds of atoms are known to chemists, and no forces known to man can change their properties or alter them in any way. The number of atoms of each kind is unalterable. These atoms may be grouped together to form molecules, which latter, when taken myriads together, form ordinary matter (like iron, water, air, &c.). Energy is, like matter, a constant quantity—all that ever happens to it is for it to turn from one kind of energy to another. Given a mass of chaotic vapour, science is capable of showing how known laws could produce the stars and our solar system. Given the simplest living organism, science can evolve our lovely fauna and flora with their master "Man."

Bert Vincent, 49, *Oxford-road, Islington, N.*

Source of Sun's Heat.

WE all know as far as the earth is concerned that if we go near either pole and take up the bottom of the sea near the land, we find diatoms, millions upon millions required to make one inch of terra firma. Why should not the sun's photosphere be composed of electric diatoms, the dead ones forming the river-like appearance, and the living ones forming what appear as rice grains? Also would not this account for the cause of so-called sun spots, some immense explosions driving these diatoms of electricity in a heap right round the so-called sun spots, which, in fact, are *holes* in the photosphere showing the sun's dark body within; also around these holes the photosphere appears brighter. If this should be correct, then we can understand how it is that this electricity coming through so many millions of miles of frozen ether, is captivated by the earth's atmosphere, which acts as a renovator, seeing that the earth is a complete electrometer. The deeper this electricity penetrates our atmosphere the warmer we feel it, which is proved by the mountains being covered with snow in hot countries and so desperately hot in the valley; also if you go up in a balloon the heat decreases, showing that the greatest heat is caused when the two electricities meet.

E. Kennedy, 16, *Eversleigh-road, Shaftesbury-park, Lavender-hill, [S.W.*

The Power of Suggestion.

A REMARKABLE instance of the power of suggestion was exercised on a patient who was not hypnotised but apparently in possession of all her faculties. A lady, who is a wonderfully sensitive subject to this influence, came under my professional charge for some slight derangement of her nervous system. If I told her that a book was a watch, it became, so far as she was concerned, an actual watch. If I put a piece of ice in her hand and told her it was boiling water, she shrieked with pain and declared that I scalded her. Every one of her senses could be imposed upon in like manner, and I have frequently controlled the action of her heart, making the pulsations slower or more rapid in accordance with the spoken suggestion. There is no doubt that if I had put a little flour in her mouth, at the same time telling her that it was strychnine and describing the symptoms of death by strychnine, she would have died with all the phenomena of poisoning by that powerful substance; or that, if I had pointed an unloaded pistol at her head, and had cried "Bang!" she would have fallen dead to the floor. All this sounds very much like hypnotism, but this lady was not in that state.

John Marr, 30, *Coburg-street, Leith.*

The Source of Life.

THE continuation of life is dependent on the consumption of nutritive materials; these are combustible substances, which, after digestion and being passed into the blood, actually undergo a slow combustion, and finally enter into almost the same combinations with the oxygen of the atmosphere that are produced in an open fire. The animal body, therefore, does not differ from the steam-engine as regards the manner in which it obtains heat and force, but does differ from it in the manner in which the force gained is to be made use of.

W. C. Newell, 122, *Brixton-road, S.W.*

GLEANINGS OF THE GLOBE.

A SCIENTIFIC observer has published a pamphlet to show that the European jaw is narrowing through the lesser severity of its labours in masticating civilised food.

THE horses of the German cavalry regiments are to be entirely shod with paper shoes, recent experiments as to their durability, &c., having proved entirely satisfactory.

A SEAMLESS steel boat, made from one piece of metal by hydraulic pressure, promises to be very desirable. It will last a great while and cannot leak.

A FRENCH scientist declares that the domestic pets of the world carry at least thirty per cent of the common contagious diseases from house to house.

THE navy of each of the great countries of Europe contains ships whose guns are said to have a range of about twelve miles. Nearly all these ships "carry" from 24 to 27 feet of water.

WHITE tar is one of the latest inventions or discoveries. It will not become soft under the sun's rays in any climate, and is expected to be used largely in cauking the deck seams of yachts.

EXPERIMENT has proved that if a delicate piece of lace be placed between an iron plate and a disc of gunpowder and the latter be detonated, the lace will be annihilated, but its impression will be clearly stamped on the iron.

IT is known that wasps' nests often take fire, and this is supposed to be caused by the chemical action of the wax upon the paper material of the nest itself. May not this account for the many mysterious fires in barns and out-buildings ?

BY a novel device heavy guns can now be aimed and fired with the greatest accuracy, without exposing the gunners and without their even seeing the object to be fired at. The principle used is that of so training the gun as to cause the object to be fired at to be reflected on a screen at the rear of the gun.

THE magnetic needle points in the same direction as to the magnetic poles in all parts of the earth. The magnetic poles do not correspond with the axis of the earth, which makes a variation of the needle at places not on a meridian which coincides with both poles. The needle is never inverted, but dips as it approaches the magnetic poles.

LIGHTNING recently performed two unusual feats. It cut half an inch off the rim of an inverted goblet on a table and left the goblet standing as it found it. The work is said to have been effected as neatly as if it had been done with a diamond. The electricity also set the hands on the dial of the clock in the same room in advance of the true time without stopping the clock.

THE Astronomer Royal for Scotland states that when the moon is half full its brilliancy is not nearly one-half as great as when it is quite full. He attributes the brightness of the full moon to the bright streaks which are then seen over the lunar surface, starting from the craters. He supposes these to be convex or concave, and largely invisible under cross light, and brightly illuminated when the sun shines full upon them.

A RUSSIAN physician, Dr. M. Reich, has reported the interesting case of a locomotive engineer, 40 years of age, who was dismissed from service on account of colour-blindness. The man was able to distinguish colours correctly and with confidence, up to the summer of 1889, when overwork and loss of sleep gave him a violent headache for over two weeks, after which for three months all objects appeared red, and then all sensation of colour disappeared. In May, 1890, he again came for examination, and had fully regained the power to distinguish colours.

THE alleged power of camphor to awaken seeds, or stimulate their germination, has been shown by the experiments of M. Henry de Varigny to have no real existence. Various kinds of seeds were sown in sand saturated with water containing camphor, as advised by horticulturists, and the germination of all was slower, instead of more rapid, than that of similar seeds in water without camphor. Germination was even retarded by camphor vapour in the air, the water having no camphor.

RECENTLY at a meeting of the Paris Academy of Science, M. Emile Blanchard read a paper on the existence of a terrestrial connection between Europe and America during the present geological age of the earth. M. Blanchard began by pointing out that a line from the north of Scotland through Orkney, the Faroe Islands, Iceland, Greenland and Labrador, by way of Davis Straits, passes from one island to another across comparatively shallow seas. Another evidence of land connection exists in the prevalence of European species of animals and plants in the eastern parts of America, especially in Greenland, where the flora of the west coast is American and that of the east coast is European.

YEARS ago it was supposed that Sirius was nearer the earth than any other star, and its light requires over three years to reach us. Now, however, Alpha Centauri, a comparatively insignificant star of the southern heavens, is known to be our nearest neighbour, and Sirius is so far removed that the human mind fails to grasp the distance when expressed in miles. The fact that light requires from seventeen to twenty years to cross the space between our little earth and this giant orb is scarcely more easy to comprehend. If one would appreciate the magnificence of this most brilliant of suns, he should not think of it as near, but rather let his mind make the vain attempt to follow a ray of light thither as it travels on, unwearied, day and night, at the rate of 186,000 miles a second for twenty years.

PYTHAGORAS, the Greek philosopher, noticed that different lengths of string or cord, when drawn taut, produced different tones. He thereupon evolved the ingeniously fanciful theory that, as the planets were at different distances from the sun, they must produce different tones as they circled through space. Seven planets were known to the ancients, and Pythagoras conceived that seven tones, and no more, must be at the foundation of all music. He thereupon concluded that music was an exact science in the same sense as arithmetic or geometry, and that its origin was in the sounds produced by the planets, which he denominated the music of the spheres.

WHAT SHALL WE DO WITH OUR DEAD?

How to dispose of the earthly tabernacle after the spirit departs has always been a question of importance to the living. Some of the most imposing buildings in the world have been tombs; the pyramids of Egypt and the Taj Mahal, that "dream in marble," will occur to everyone. The widely prevalent notion that the dead require the conveniences needed in life has preserved to us many relics of nations passed away, and to the habit of lavishing ornament upon places of burial we owe some of our finest specimens of early art. Even to this day, and in this Christian country, we attach an importance to the place and the manner of burial that seems hardly consistent with our professed belief that—

> What the women lave
> For the last sleep of the grave
> Is a tent that I am quitting;
> Is a garment no more fitting;
> Is a cage, from which at last
> Like a bird my soul hath passed.
> * * * * *
> Loving friends! be wise, and dry
> Straightway every weeping eye.
> What ye lift upon the bier
> Is not worth a single tear.
> * * * * *
> Cease your tears, and let it lie;
> It was mine, it is not I.

The sentiment, however, did not begin nor end with us. So far back as we find traces of man upon earth, so far also do we discover signs of his treatment of the empty "cage;" and down to this year of grace, 1891, the customs of humanity are as varied, as curious, and as interesting as at any period in the world's history.

In glancing over the subject, we find a noteworthy fact that, whether the "garment no more fitting," be buried or burned, mummified, cast away, or eaten, some part of it is in almost every case preserved. With many peoples the chosen relic is the skull, which in Australia is made into a drinking cup and kept for a momento as well as a common convenience by the next of kin; in some parts of Polynesia the skull of the "dear departed" is hung around the neck of a widow by a cord, and worn during the rest of her life; and in one of the Kingsmill Islands it is oiled, decorated with flowers, and daily presented with food.

In some races the affectionate care of the survivors extends to all the bones, which are distributed among the friends, each one of whom mourns over his one bone as if it were the whole body. Again, they are arranged in various fanciful ways, tied in a bundle and painted red, by one tribe; packed in a basket decorated with beads with the skull for a lid, by another; hung from the roof, or placed in an urn, or wrapped in bark and carried with the tribe; or, finally, painted in stripes and dried in smoke.

Alexander the Great—as history tells us—was preserved in honey, and some of the royal Britons in wax; but the most famous embalmers, as we all know, were the Egyptians. Would they have taken so much pains, we wonder, if they had suspected they were preparing curios for the museums of impertinent nations yet unborn? Perhaps the most peculiar mode devised by man is the preservation of rich Thibetans in the form of cakes. The empty "hut" being reduced by fire to ashes, is mixed with wheat flour and kneaded into cakes of graduated size, piled in a pyramid and deposited in a small tower of suitable form.

Nearly all people cherish, in one way or another, the bones of their friends, and they may be conveniently divided into two great classes—those who take measures to dispose of the more perishable covering, and those who leave the work to the slower processes of Nature. Among the first-named are some exceedingly strange customs, as that of the Caribs, who hang the empty case in water infested with extremely voracious little fishes, and in a few hours draw up the skeleton perfectly cleaned, paint it red, and hang it under the roof of the hut; and, perhaps even less agreeable, that not long ago in vogue among the Thibetans and others, of keeping a race of sacred dogs for the special business of quickly disposing of the cast-off human garment; and, again, the habit of the ancient Persian, who invited wild beasts to the feast, and considered their speedy acceptance a special honour; most repulsive of all, some tribes of Tartars, and the Fans, an African people, who take upon themselves the delicate task of disposal—with pleasure, it is said. With this latter group must also be placed the ancient Irish and Briton, and many South American Indians. Most interesting of the practices of "living sepulchres" is that of the Parsees of India, whose famous Towers of Silence are well arranged buildings where the necessary work is done quickly and unseen of men, by vultures "sent by God," as they say, and the bones preserved in one great central well together.

The most widely-extended fashion of forcibly resolving the body into its elements is by burning, which has been in use almost from the beginning of man's life on this planet, and is to-day rapidly growing into favour with enlightened peoples. Before the advent of Christianity it was the nearly universal practice. The Greeks and Romans, the Etrurians, Hindoos, Siamese, Germans, Scandinavians, and many Indian tribes of the Western world, all burned their dead with more or less ceremony, and some of them do still. Certain Australians put the body in a hollow tree, and make of that a funeral pile; the Gualala of California burn the departed to prevent their becoming grizzly bears; and the Semels, another tribe, glorify their chiefs by great pyres heaped with, finery and valuables.

To the cremationists must be added many people of Asia, among whom the fashion is still in full vigour. Some races, both savage and civilised, sacrifice the living on the funeral pile, the victims being, of course, the helpless wives and servants. Most of them are merciful enough to strangle or otherwise kill the doomed ones, but it was reserved for the "mild and gentle Hindoo" to invent and carry out the most cruel and brutal custom on record.

Of the races who let Nature do the work at her leisure perhaps the most striking are those who wall up the door and leave the deceased in possession, since this comes the nearest we can hope to get to taking our riches with us. Such were the ancient Peruvian Incas, whose palaces were closed and deserted with all their treasures in them, although the dried and preserved body took its place with its ancestors in the Great Temple of the Sun, and the dying Eskimo left in his snow hut, with food and light at hand, free to depart when he chose.

Unique among men is one who saves his friends trouble by burying himself. The aged Australian, feeling death approach, seeks out a hollow tree, climbs it, drops down inside, and is from that moment numbered among those who have "passed on."

Other methods are observed by the red men. Some of them are exposed to the winds of heaven, upon platforms raised on poles, as are the Indian tribes of the Dakotas, Blackfeet, Mandans, and some Sioux; others are placed in trees, like the Ahts, of Vancouver's Island, where the height of the body indicates the social position of the departed; and not a few simply lay the cast-off "garment" on the bosom of its Mother Earth for the winds and storms

to dispose of. In one place the body, in a canoe, is committed to the "mother of all things," the sea; and among the Hindoos it is often devoted to the sacred Ganges, lying on a platform with candles at the corners.

The largest number of civilised people, including all Christendom, bury in the earth, and, far less wise than the simple Indians, whose ways we scorn, endeavour to keep as long as possible the "shell from which the pearl is gone" from its natural and much-to-be-desired fate, dispersal into the elements. This custom of burial arose partly from the desire to imitate the dead Christ, who—as a Jew—was buried, partly from a belief in the resurrection of the body, and also influenced, no doubt, by the difficulty during the early persecutions of performing Christian rites at a burning which must necessarily be public.

The curious and peculiar manners connected with burial in the earth are almost numberless, and edifying in the extreme. The position differs: some sit as in life, and others are held standing, although most lie naturally. The direction of the head varies. Many of the Indians turn the face to the west, toward their "happy land;" a few turn to the east. The dead Japanese heads towards the north, for which reason the living never sleep that way, and, to avoid the chance of it, carry a compass, or mark its points on their houses. The Bongos of Africa carry the distinctions of sex into the grave, and set the faces of men to the north and of the women to the south; while the Niam-Niam, a neighbouring tribe, consider the east the point of honour, and the west good enough for the weaker sex.

Urn burial has attracted much attention since it was brought prominently before the world at the Vienna Exhibition some 15 years ago. There has been a spasmodic revival of interest in this manner of disposal of the body both in France and Italy, but nothing of importance till this Exhibition. A warm convert, Sir Henry Thompson, wrote enthusiastic articles for the leading magazines, and an earnest controversy was kept up for some time. The result has been discussion all over Europe, the establishment of cremation societies, and the building of crematories, for the new method differs greatly from the ancient fashion of burning on funeral pyres. The pyre, however, is still in use in India and other parts of the world, reaching its utmost extravagance in Siam, where bodies of the royal family are burned in gorgeous and elaborate temples built of wood and inflammable materials, but adorned and decorated, painted and gilded, to exactly represent their finest architecture.

There are many things to commend cremation aside from the pretty Indian fancy that fire, the purifier, completes the deliverance of the soul from its long-time prison of flesh, and by the smoke and ascending heat forms a path on which the spirit ascends to its home in the skies, or as one tribe has it, the soft warm chariot conveys the released and purified soul towards the sun.

We, of course, scoff at this, but there are potent arguments that should influence even our profound wisdom—sanitary reasons, the health of the living; economical reasons, the much-reduced expense; even sentimental reasons, the possibility of preserving the remains from desecrating touch. Most powerful of all in its favour is the prevention of premature burial. All these are on the side of cremation, and against it is but one—sentiment. It seems more beautiful to lay our friends to rest, softly pillowed, shrouded in satin, inclosed in rosewood, covered with flowers, and of anything beyond we refuse to think. We erect the imposing marble, set out the blossoming plant, and carry flowers to the spot. The cemetery appeals more strongly to the sentiment than does the crematorium. We find no fault with sentiment, but we think it will more appropriately cling around an urn containing the pure ashes of what was once a loved form than about the unspeakable and unimaginable horrors covered by our flowers.

PHRENOLOGY EXPLAINED.

By Stackpool E. O'Dell.

Author of "Phrenology: its Truthfulness and Usefulness," "Old St. Margaret's," "Merciful or Merciless?" "Brompton Lectures," "Mental Troubles," etc.

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V.

The next faculty in the perceptive group is that of weight; its organ is localised next to size, on the ridge of the eyebrows. We expect to find this prominent in all those who possess ability to balance themselves or remain in the perpendicular when climbing, standing on a height, a wall, for instance, or looking down from a height, such as a precipice. Sailors require it, so as to enable them to keep their balance when rocked to and fro by the sea, as they cling on to a rope or a mast. Bricklayers, hodmen and slaters must possess this organ in a state of activity. It will possibly be said that these men obtain their special ability by practice, and so they do. All special abilities are developed by practice, which practice brings a certain portion of the brain into activity, and thus is the ability acquired. Some people cannot climb or stand even upon a small height without an inclination to fall. There are people who cannot look out of even a first-floor window with any degree of pleasure; and, as for crossing a bridge, they will not do it except as a matter of necessity, and although they may have tried to overcome this feeling, which has deprived them of much pleasure, they have not been able to succeed. As many of these sufferers are in other respects the same as ordinary people, we have reason for concluding that there is some portion of the brain deficient that should rule this part of the muscular system. This faculty likewise gives us accuracy in calculating the power required for resistance, so it is requisite in a special degree for those engaged in mechanical pursuits. The organ of weight will tell us that a sledge-hammer is not required in order to fasten a tack into a wall. We perceive that those people who walk heavily, shaking the room by the unnecessary force they display, have this organ small or inactive. A lady who presides at a tea-table, if she be deficient in this organ, will make much clatter and noise with the tea cups, etc.; while another who has no more taste in other matters, will have sufficient judgment in this respect, to expect concussion from resistance, and will thus avoid the unseemly noise. With a little effort in studying the resistance of bodies and the required amount of force for our various actions, we should get on much better and save much uselessly expended vitality, and thus conserve energy.

The next perceptive faculty is colour, the organ of which is localised a little further outward, in the vicinity of weight. The size and activity of this organ adds much to the enjoyment of life. We shall understand this if we try to imagine a colourless world. To those who possess this organ only in a trifling degree the world is almost colourless. They derive no distinct enjoyment from it. If they happen to preside over a home and have the responsibility of its

arrangement, either cold monotony from the absence of colour or glaring inharmoniousness will be perceptible. So far as the beauty of colour is concerned, Nature has neither beauty nor glory to those who are deficient in ability to discern colour. This can be seen in nearly every family. One is pleased with a walk in the country, the garden, or the park, because of the colour that is to be seen ; the grass and the trees will present shades and harmonies of the most pleasing nature, while the more highly-coloured flowers will be looked upon with pleasurable sensations, which can be felt only and never explained. To go through a picture gallery with this faculty of colour dormant is comparatively tiresome, but bring this faculty into activity, and it is the "open sesame" to a thousand beauties. The difference between this faculty cultivated and uncultivated resembles that of the artist and the blind man. No other faculty will make up for this deficiency. To show that it does not depend upon the brain as a whole, but, like all the other faculties, has a localised organ, man may have all the artistic abilities required for high excellency in every branch of art except that of colour. He may have the ability to be a sculptor but not a painter. To cultivate this faculty is to add much to the refinement of the mind.

THE VERY WORST SMELL.

An odour has been found so frightful that the discoverers have been obliged to abandon its preparation. MM. Bauman and Fromm, in experimenting at Freiburg, in Brisgau, upon the organic sulphur derivatives, caused hydrogen sulphide to act upon acetone, and obtained besides trithioacetone, small quantities of a definite compound non-volatile and crystalline, C15 H28 S4. At the same time there is found a very volatile body, having such a horrible odour that ethylmercaptan, ethylene-mercaptan and the other volatile sulphur compounds are perfumes compared with it. The discoverers have not been able to obtain this compound in a pure state, but they do not doubt that it is monosulphuretted acetine C5 H6 S. As they were one day distilling the product of the reaction of 100 grams of acetone with hydrochloric acid and hydrogen sulphide, with a very perfect arrangement for its condensation, and avoiding a sensible loss of the products of the reaction, the atmosphere of the whole surrounding district of the city was contaminated within a radius of about half a mile. Every effort to obtain this substance in a pure state raised such a tempest of protestations and complaints against the laboratory that the experimenters were obliged to discontinue their researches.

A FUNNY FEAT.

Upon holding a wide-monthed bottle horizontally, and placing a cork loosely in its mouth, it would naturally be thought by the uninitiated that were he to blow against the cork, it would enter the bottle. Such is not the case, however, for the moment the current of air is produced, the cork, as if projected by an internal spring, makes its exit with force from the neck and strikes the lips of the experimenter.

The explanation of the phenomenon is easy. Upon blowing in the confined space of the bottle, the internal air is compressed, and then expands and throws the cork out. The stronger the current of air is, the more forcible will be the projection of the cork.

In order to succeed, a few precautions are necessary. The bottle must not be wet internally, and the neck must be absolutely dry, for dampness might cause the cork to stick to the glass, and make success doubtful.

WHEN THE BODY RUSTS.

The tissues and organs do not all mature at once in man. It results that when we reach mature age our capacity for some exercises has notably diminished, while for others it has preserved its complete integrity. At forty-five years the bones and muscles have lost none of their solidity and vigour. The aptitude for exercises of force and bottom continues. But we cannot conclude from this that the man is as apt in all forms of exercise as he was at twenty-five. While the motor apparatus proper is not sensibly modified in the maturity of life, particularly if one has kept it up by regular practice, this is not the case with some other apparatus that begin, to decline earlier—notably with that for the circulation of the blood. The heart and the arteries, in spite of the most rational exercises, lose with age a part of their serviceableness, because they lose some of their normal structure.

After thirty-five years of age we recognise, even in conditions of perfect health, a tendency to decline of sensibility and pliancy, or a defect in nutrition that lessens the suppleness of the vessels and causes them to lose a part of their elastic force. This change, which goes on with increasing age, has received the picturesque designation of the "rust of life." Rust in a machine is the result of a lack of work, while deterioration of the blood-vessels is connected with the working itself of the human machine ; it is the result of the wearing out of its most essential wheel-work, and it is to be observed most prominently in men who have carried exercise or work to the point of abuse. All directions for exercise in mature age, all precautions to be taken in its application, are controlled by this great physiological fact of the lessened capacity of the vessels to support violent shocks. This imperfection of the arterial system is the cause of a considerable tendency to shortness of breath ; and it is by this shortness of breath that the man's diminished capacity for resistance is shown.

The differences in the structure of the arteries, even though they may not be carried so far as to denote disease, make the man of fifty years much more vulnerable than the young man : and vulnerable in precisely the organ most essential to life. It is, in fact, the heart that suffers in case of forced exertion, the consequences of a deficient elasticity of the arteries. Every beating of the heart represents the piston-stroke of a force-pump, and the blood-vessels are the pipes through which the liquid flows to carry life to the furthest molecules of our body. But these vessels are not inert conductors ; they are endowed, in a healthy condition, with an elasticity which permits them to react at each pulse of the heart, swelling under the pressure of the sanguineous wave, and then contracting and returning to the liquid the impulse which they have received from it. The liquid, striking upon the wall of a fully elastic artery, does not suffer at once the arrest which it would suffer on meeting a rigid wall. A billiard-ball, driven against a very elastic cushion, rebounds with nearly as much force as it had when it started. An artery which has lost its elasticity is, as to the column of blood that comes against it, as an ivory ball to a cushion that does not spring. And as the billiard-player must strike more vigorously upon the ball to make it perform its run when the cushions do not spring, so the heart, when the artery has lost its elasticity, must exaggerate its effect at the systole, (the moment of contraction when the blood is forced into circulation) to enable every molecule of blood to traverse the circle of the vessels and return to its point of departure. In short, the less elastic the arteries, the greater the effect the heart has to make to secure equal work. Each heart-beat, then, of a man whose arteries have

beeome old, is the occasion for an excess of labour by the museles of the heart. The inerease in expenditure of force passes unnotieed if the beatings retain their normal slowness, but beeomes very sensible when they are quickened. There are some exereises whieh cause the number of heart-beats to double in a few moments. The resultant fatigue of the organ, whieh has already been brought to the point of overwork by the eontinual exeess of work it has had to do, is easy to eoneeive.

The most natural consequenee of fatigue of the heart is a momentary diminution of its energy ; and when the organ is weakened, the impulse it gives to the blood is no longer suffieient to cause it to traverse as rapidly as it ought the vessels through which it circulates with most diffieulty, either on aecount of their narrowness, or of the mass whieh is precipitated into them at once. Hence what are ealled passive eongestions of the internal organs, and partieularly of the lungs. Congestion of the lungs is a frequent eonsequenee in elderly men of exercises which aeeelerate to excess the rhythm of the pulse, and is shown by shortness of breath. This, whieh is more prompt in men habituated to physical exereises, is one of the first symptoms of arterial deterioration. It is a warning whieh it would be a grave imprudence not to heed. The elderly man should, therefore, give up all exereises of speed like running, and all those in which energetie efforts are added to speed, like rowing in matehes. We see men of exceptional powers of resistanee eontinuing to praetiee exercises of speed till they are forty-five years old ; but it is well to know how indulgence in ehampionship feats late in life usually ends.

Exereises of foree would be as badly chosen for elderly men as exereises in speed, and for the same reason—that they fatigue the blood-vessels and the heart. Every museular act that requires a eonsiderable display of foree inevitably provokes the physiologieal aet ealled effort. A porter in lifting a heavy burden is obliged to make an effort, as does also the gymnast who executes an athletic movement with his apparatus. These are eommon faets of observation, and impressions which everybody has felt. If we put all possible energy into any movement, respiration stops at once, the museles of the abdomen stretch, and the whole figure is stiffened, while the veins swell and mark salient sinuosities on the neek and forehead. Effort is translated, in fact, by a eonsiderable pressure of the ribs on the lungs, and through this upon the heart and large vessels ; under the influence of this pressure there is a reflow of the mass of the blood toward the smaller vessels and distention of their walls. When these vessels are tending to lose their elasticity, in eonsequence of the modification of structure observed in mature age, the violenee to which the effort subjects them results in the aggravation of their inert state.

While the elderly man has less capacity for some forms of exercise than the younger adult, he has no less need than the other of the general and loeal effects of exercise. It is in the earliest period of mature age that the most characteristic manifestations of defects of nutrition—obesity, gout, and diabetes, in which lack of exercise plays an important part—are produeed ; and the treatment of them demands imperiously a stirring up of vital combustion. Placed between a conviction that exercise is necessary, and a fear of the dangers of exereise, the mature man ought, therefore, to proeeed with the strietest method in the application of this powerful modifier of nutrition. It is impossible, however, to trace methodically a single rule for all men of the same age, for all do not offer the same degree of preservation. We might, perhaps, find a general formula for the age at which the museles and bones have retained all their power of resistance, and at whieh the heart and vessels begin to lose some of their eapaeity to perform their funetions. The mature man can safely brave all exercises that bring on museular fatigue, but he must approaeh with great care those which provoke shortness of breath.

The formula is thus subjeetive in its applieation, in the sense that it looks rather to the feeling of the person than to the exereise itself ; and from this point of view it is exaetly applieable to all. One person is taken with shortness of breath at the beginning of a fencing bout ; another one of the same age can fence without losing breath, while he tires his legs and arms. Most frequently the question of measure in the praetiee of exercise is more important than the ehoiee of the kind. Some exercises are dangerous only on account of the temptation they offer to impetuous temperaments to pass beyond reasonable bounds. Thus feneing, whieh prematurely wears out too enthusiastic swordsmen, may remain a very hygienie exereise for the man of fifty years, provided he is enough master of himself to moderate his motions. There are exercises, however, which of themselves imply the neeessity of a violent effort or a rapid suceession of movements ; among these are some of the exercises with gymnastie apparatus, wrestling, and running. These should be absolutely prohibited to the elderly man. This rule cannot be invalidated by the rare examples of men who have been addicted to such exercises till an advanced age. Such men have continued, in respect to their structure, younger than their age ; they have kept their elastie arteries as other persons keep their blaek hair. They are physiological exceptions, and general formulas do not regard exeeptions.

The need which the elderly man feels of a stimulation of his organie combustion may be satisfied in other ways than by exercise of strength and agility. Walking is the most hygienie of all kinds of exereise for the elderly man, provided it is prolonged enough to represent a sufficient amount of work. But it is necessary to regard the soeial exigeneies, whieh refuse to give everybody the desired number of hours, and compel another choiee. There are many other exercises that exact a larger expenditure of force than walking, without going beyond the degree of effort and rapidity that the arteries of the elderly man ean safely bear. Many of what are ealled open air games, like lawn-tennis, and even rowing, when practised not for raeing but as a reereation—that is with liveliness graduated to the respiratory eapaeity of the rower—provoke, for example, in one or two hours, an elimination of the products of disassimilation and an acquisition of oxygen equivalent to what one can get from eight or ten hours of walking. They permit the busy man to gain time, compensating for the shorter duration of the exercise by its intensity ; but that in such a way that he can get the general consecutive effects of exercise while avoiding its general immediate effects, superactivity of the circulation of the blood and of respiration,

We ought to look also to exercise for loeal effects ; in order. in the first place, to keep the joints supple and counter-balance the tendeney to inerustation of the cartilages, which is one of the consequenees of age ; and in the seeond plaee, to keep the muscles as a whole in suffieient strength and volume. The muscle is "the furnace of vital eombustion," and in developing the museular tissue we favour the aetivity of combustion and the destruction of the refuse of nutrition. For the satisfaction of these requisitions, such exereises are adopted as might be called analytieal, inasmuch as they bring the whole muscular system into play, not by the work of the whole together, but by a series of suecessive move-

ments that call the various muscular groups into action severally one after the other. It is important, in order to preserve the easy working and suppleness of all the articulations of the body, to subject them to movements extending to the extreme limit of possible displacement. We might also, by localising the work successively in limited muscular groups, effect very intense muscular efforts without any fear as to their reaction upon the organism or upon the circulation of the blood.

SUPPER AND SLEEP.

Many persons, though not actually sick, keep below par in strength and general tone, and it may be that fasting during the long interval between supper and breakfast, and especially the complete emptiness of the stomach during sleep, adds greatly to the amount of emaciation, sleeplessness, and general weakness we so often meet.

Physiology teaches that in the body there is a perpetual disintegration of tissue, sleeping or waking; it is therefore logical to believe that the supply of nourishment should be somewhat continuous, especially in those who are below par, if we would counteract their emaciation and lowered degree of vitality; and as bodily exercise is suspended during sleep, with wear and tear correspondingly diminished, while digestion, assimilation, and nutritive activity continue as usual, the food furnished during this period adds more than is destroyed, and increased weight and improved general vigour is the result.

All beings except man are governed by natural instinct, and every being with a stomach, except man, eats before sleep, and even the human infant, guided by the same instinct, sucks frequently day and night, and if its stomach is empty for any prolonged period, it cries long and loud.

Digestion requires no interval of rest, and if the amount of food during the twenty-four hours is, in quantity and quality, not beyond the physiological limit, it makes no hurtful difference to the stomach how few or how short are the intervals between eating, but it does make a vast difference in the weak and emaciated one's welfare to have a modicum of food in the stomach during the time of sleep, that, instead of being consumed by bodily action, it may during the interval improve the lowered system; and were the weakly, the emaciated, and the sleepless to nightly take a light meal of simple, nutritious food, before going to bed for a prolonged period, nine in ten of them would be thereby lifted into a better standard of health.

Many cases of disease, in addition to local and constitutional treatment, need an increase of nutritious food, and by consuming a bowl of bread and milk, or a glass of beer and a few biscuits, or a saucer of oatmeal and cream before going to bed, for a few months, a surprising increase in weight, strength, and general tone results; on the contrary, persons who are too stout, or plethoric, should follow an opposite course.

PAPER GAS PIPES.

Paper gas pipes are now being made from strips of manilla paper, in widths equal to the length of the pipe to be made. These are passed through a vessel filled with melted asphalt, and then wrapped firmly and uniformly around an iron core, until the required thickness is attained. The pipe is then subjected to powerful pressure, after which the outside is strewn over with sand, and the whole cooled in water. The core is then removed, and the inside of the pipe coated with a waterproof composition. These pipes, are claimed to be perfectly gas tight, and are said to be much cheaper than iron pipes.

ELECTRICITY ON THE HEARTH.

Very little has been done up to the present time in heating by electricity, and yet enough has been accomplished to demonstrate its practicability and its superiority over all other modes of heating. The common belief is that heating by electricity would be too costly. It is generally conceded that in all other particulars it is superior to other modes of heating; and when electricity is generated a little more cheaply than it is at present that objection will be removed. The only objection, therefore, is that it is not economical. This was exactly what was said about electric lighting when it was first proposed, but after it came into use it was found that it could be supplied as cheaply as gas or other illuminants, and to-day it is used in all parts of the world, and people cannot speak too highly of its merits.

One well-known inventor, while he admits that electric heating is undoubtedly the most convenient and the ideal method of artificially warming our places of habitation, has said that it will not be economical until we can transform the heat in the coal directly into electricity without the intervention of boilers and engines. This inventor is wrong, and certainly could not have examined the subject fully. Even if we are compelled to employ the steam engine in the generation of electricity for heating, as in many cases at present, when we cannot get water power, heating by electricity is just as economical as heating by coal. We need not wait for the time, though it may be close at hand, when electricity will be generated directly from the heat of coal; if it is as economical to heat by electricity now, the immense advantage possessed by this mode of heating over other modes should and will soon give it the preference.

The same inventor said, although it is not understood why, as will be seen further on, that electric heating costs nine times as much as ordinary heating, so that to heat by electricity it would be necessary to burn nine pounds of coal to get the heating effect of one pound. This he explains by the fact that under the best conditions we realise in electricity about one-tenth of the energy of the coal consumed, and when we turn that ten per cent. of electricity into heat we simply get nothing more than ten per cent.; therefore, to get electric heat equivalent to the heat in one pound of coal it is necessary to burn ten pounds. This inventor seems to have lost sight of the fact that when employing a coal furnace or stove for heating we get only about 40 per cent. of the energy of the coal, and that then we must use a superior and expensive grade of coal costing from three to six times as much as the grade of coal that can be consumed at a large electrical power station. It is possible for us to get 60 per cent. of the total energy as useful heat from a first class furnace if carefully and properly regulated; but stoves do most of the heating in towns, and they give but one-fourth, or 25 per cent., of the total energy in useful heat. Three-fourths of the heat passes up the chimney. Air rushes through the crevices of doors and windows in draughts which are injurious to health.

We can get 10 per cent. of the heat energy expended at a central station, and in using a stove we may get 25 per cent. Electric heat, therefore, would cost two and a half times more than heat derived from the consumption of coal in a good stove, if the same grade of coal were used in both cases; but as the central station can and does use coal costing one-fourth or one-third of what we must pay for coal to burn in a stove, electric heat can be obtained as cheaply as the heat obtained by means of a coal stove.

It is evident from the above that electric heat is as economical as the heat ordinarily derived directly from coal, but when we consider the numerous advantages of electric heating it

appears to be more economical still. Take, for instance, a house heated by electricity in a town. Let the current come from a central station and heat coils of iron wire. These coils are very cheap, may be placed in any part of the house and arranged in almost any conceivable and desirable way to produce the best results for heating or cooking purposes. These coils can be placed just under or around the vessel holding the article to be cooked or baked. Less heat than usual would be required, for no soot would collect upon the bottom of the containing vessel. The fire risk would be much less than at present, as the wire never need be hot enough to cause fires or can be easily and completely protected. The heat supply can be turned on or off instantly ; thus there will be no loss of fuel when the need of heat has ceased. This applies with great force to summer use. In heating, cooking or baking, the temperature can be kept uniform or controlled as desired. In cooking or baking, many things are spoiled and wasted because the heat cannot be regulated as desired or appears to be different than it really is. Many regulators have been devised for the automatic regulation of coal heaters, but none of them accomplish their purpose fully, for the reason that a coal heater cannot be automatically regulated except in a small degree. We must visit the furnace or stove now and then, supply it with coal, rake down the ashes, carry them out, clean the soot out of the flues so that it will have draught, and many other things. None of these things would be necessary with an electric heater. It can be thermostatically regulated all the year around, and when the weather is warm enough or whenever from any cause the temperature of a house is raised above the point beyond which artificial or electric heat is not required, it will shut itself off and there will be no waste whatever ; when the temperature falls below the predetermined point the current will be automatically put on again, so that the temperature will be kept uniform and healthful.

Without rising in the morning, a button touched at the bedside may be made to turn the heat on in any or all parts of the house. The nuisance of kindling, smoke, gas, ashes and soot will be abolished, and no stove-pipes, chimneys, shovels, cinder sifters, fire wood, coal, or coal scuttles will be needed. Taking into consideration the cost of the articles above named, the trouble and fire risk, electricity will not only be found as cheap, but much cheaper than heat supplied directly from coal as usual.

When the dynamo at the central station can be driven by water power, as is done in very many places at present and will be done in the future at a great many more, or when the the central station is at places, where coal mines are situated, greater economy can be obtained. A comparison of the respective costs of water and steam power, shows that the latter costs two and a half times as much as former.

It will be apparent from the above that electric heating would cost two and a half times as much as heating by stoves, if the same grade of coal were used in both cases, and in using water power to generate electricity the heat will cost the same as when produced in stoves, even neglecting the cost of the many articles above named that would be dispensed with.

There have been many forms of apparatus invented for the purpose of electric heating, but one that particularly commends itself for ingenuity is a floor or floor mat that can be electrically heated. This form of heater is capable of distributing the heat throughout the room in which it is placed more uniformly and exposes a large radiating surface to the atmosphere in all parts. Floor mats are commonly used in railway carriages to prevent wear upon the floors and to keep persons from slipping. Mats the same or similar to those already in use are employed for the heater, the only essential requirements being that the mats be provided with heat-radiating conductors and connected to suitable supply conductors.

These mats are perfectly safe and effective. A very low tension current is employed to heat the mats and this current is passed through them. They can be and are arranged in some cases so that it is impossible to touch the conductor of the mats, but even if the conductor in the mat is not protected or shielded, it is utterly impossible to receive a shock by contact in any manner with the mat. In some cases flexible steel coiled spring mats can be employed for the purpose, as they offer the required electrical resistance, expose a very great radiating surface, and are easily removed for cleaning purposes.

Those who admire the bright fire in a grate can enjoy it without the consumption of coal, wood, or other fuel by placing the incandescent lamps or an arc lamp beneath a body of glass, formed and covered, if need be, to represent a bed of coals or pieces of log wood, placed in the fireplace. The back and sides of the fireplace may be formed of mirrors if desired to magnify the effect, and if the heat is also desired, a small flat electric heater may be placed beneath, at the back of the ash guard.

OLD AGE AND HOW TO ATTAIN IT.

The recent appearance of an Italian work concerning the "Hygiene of the Head," the publication of statistics in Germany as to the average age in each of the learned professions and in several of the trades, and the general inquiries of the Austrian Society for Popular Education as to how prominent Austrians and Germans have grown old, have brought into public discussion abroad the subject of old age and how to attain it. The German statistics have given, perhaps, the most food for new reflection in the statement of the comparative average ages of professors, scientists, and authors on the one side, and artisans, lawyers, and doctors on the other. The classification of the data in the biographies of some 7,000 persons resulted in the following allotment of an average term of life to men in the professions :—

Speculative sciences...	Mathematics, Philosophy, Theology,	..... 71 years.
Beautiful sciences ...	Poetry, Drama,	..... 70·9 years.
Abstruse sciences ...	Archæology, Philology,	..... 70·2 years.
Public affairs	Statesmanship, Generalship, Philanthropy,	.....68·18 years.
Natural sciences	Chemistry, Physics, Anatomy, Physiology, Medicine,	..... 68·7 years.
Fine arts	Sculpture, Architecture, Music,	..... 67·6 years.

The average age in years and months for men who are not mostly or exclusively brain workers is :—

School teachers, gardeners and butchers ...	56	10
Tradesmen	56	9
Lawyers and financiers	54	3
Doctors	52	3
Bakers	51	6
Shoemakers	47	3

Smithies	46 3
Tailors	45 4
Stonebreakers, printers, etc.	40

The statistician also looked up the biographical data in the lives of 1,200 prominent men, and found that 290 of them had lived beyond the age of 80. At the time of death 175 were 80 to 85 years old; 56, 85 to 90; 39, 90 to 95; 10, 95 to 100; 10, 100 to 120.

How have so many men of prominence and onerous duties in public life managed to eke out more than their allotted threescore and ten? The Austrian Society has tried to get a general answer to this question by asking old men in the public life of Austria and Germany just what each ascribes his multiplicity of years to. Major-General Baron Von Hauser in Graz, 91 years old, who has fought in four wars and thirty-four battles, walks for three hours every day, whether wet or fine, and thinks that this habit alone has preserved his health.

The Chief of Division Carl Von Ransonnet, 89 years old, ascribes his continued robustness to the simplicity of his daily life. The Lieutenant Field Marshal Von Maechio, who, although 87 years old, is still a famous mountain climber, has taken a cold bath every morning since his fourteenth year, and believes everyone else may lengthen his life by doing the same. Up to ten years ago he skated wherever there was ice. Count Pfeil-Burghaus, in Silesian Prussia, also 87, attributes the ripeness of his age to cold shower baths.

Anton Ritter Von Schmerling, the head of the Austrian Bench, is 85 years old. He wrote to the Society for Popular Education:—"I have taken only simple food, have had no mouth for delicacies, and have never smoked. I have, as a rule, drunk only water." Court Counsellor Von Turner expressed the opinion that he had lived to be sound at 83 because he had "lived simply and never been drunk."

The Speaker of the Austrian House of Representatives, Dr. Franz Smolka, is 89 years old, and sturdy beyond most deputies of 50. When he was a boy his father compelled him to rise early every winter morning and run about barefoot in the snow. This harsh training enabled Smolka to withstand the effects of close confinement in a damp prison cell from 1841 to 1845. Privy Councillor Von Plevner, 79 years; General Von Koller, 77 years; and the industrial Baron Von Rosthom, 76 years, ascribed their undiminished vigour to plain living. The Land Marshal Von Felder, of Lower Austria, says he feels fully as strong and exuberant as he felt fifty years ago, because he has, throughout his life, made walking tours throughout Europe every summer, with his pack on his back and his staff in his hand. One voice from France also answered the Society's questions. "I have worked steadily," are Jules Simon's words, "and, thanks to my moderation, have to-day the same habits and energy that I had thirty years ago."

What does the accumulation of years mean for the work of the brain? This is, perhaps, the most interesting question answered by the Italian writer, Paolo Montegazza, in his "Hygiene of the Head." "Whoever is not a good minister of state, a good general, or a good physician at 30 years will never be one," he writes. "Beranger was an author at 16, and Burns at the same age was celebrated in his native village. Calderoni wrote at 14, and Goldoni at 8 put together a comedy that astounded all. Ovid was a child poet. Pope published at 16 his idyls. Schiller at 23 was famous for his "Robbers." Goethe was a wonder child. Lord Chatham was at 27 an M.P., and his son was an M.P. at 21, and shortly afterwards minister. To the same end may be also cited Fox and Canning. The early maturity of great artists and composers is too well known to need comment. In science early maturity is rare, because the collecting of the necessary knowledge is a slow process. The minimum and maximum of early maturity are to be found respectively among composers and scientists, for it is a natural law that the most nearly automatic energy of thought, which is at once the most irresistible and the most independent of training and outside influence, is the most early developed. It must be said, too, that the lateness of maturity among scientists is more apparent than real. A scientist can hardly at 16 publish to the world a great discovery, yet can have gathered the materials for making such a great discovery in the future.

The earliness of the maturity of thought apparently varies in various places and at various periods. In France and England the dramatic talent begins to show itself after the twenty-first year. It grows steadily, reaches its full bloom and energy between twenty-five and thirty, becomes more robust up to fifty or fifty-five, and then begins to wane. Talent for writing tragedies is of earlier development than talent for writing comedies, because it is a product of glowing passion and is developed accordingly in about the twenty-fifth year. Among the great French writers of comedies, on the other hand, we find the most productive age between thirty and forty-five. Very great minds not only ripen very early, but also maintain their bloom longer than do smaller minds. Titian still painted in his ninety-ninth year. Hayez did his best piece when past threescore and ten. Manzoni studied after he had become an old man, and Bufalini spoke most eloquently at ninety. Cicero in old age wrote like a boy, and Humboldt published the fourth volume of his "Kosmos" in his ninetieth year.

No country in the world furnishes so many illustrations of the remarkable activity of old students as does Germany. The German professor is a man who does not spare himself early or late, who attends all his lectures and classes with clockwork regularity, and yet finds time to write a whole little library on his speciality. Roscher, of Leipsic, the founder of the historical school of political economy, and still writing at 73; Knies in Heidelberg doing his best work in his 70th year, Rau (Germany's Adam Smith) in the harness when he died at 78, Savigny, Ranke, Lorenz Von Stein, Windscheid in Leipsic, and scores of other learned professors, who are or have been great, have shown pretty conclusively by their length of life and their unceasing activity in their ripest years that the hardest brain work does not necessarily wear out mind or body.

LAUGHTER RESTORES LIFE.

A gentleman was suffering from an ulcerated sore throat, which finally became so swollen that his life was despaired of. When his household came to his bedside to bid him farewell, each person grasped his hand for a moment, and then, turning, went out weeping. A pet ape, which had modestly waited till the last, then advanced and grasped his master's hand for a minute, also turned and went away with his hands to his eyes. This assumption of deep grief, which it is hardly possible the animal could have really felt, was so ludicrous in its perfection, that the sick man was seized with an uncontrollable fit of laughter, which broke the ulcer in his throat, whereby his life was saved.

The great Erasmus laughed so violently, while reading the Epistolæ Obscurorum Virorum (letters of obscure men against the monks), that he broke an abscess and saved his life.

A somewhat similar story is related of the celebrated grammarian, Urbain Domergue, who had an abscess in his throat, which broke in a fit of passion, with which he fell on his

physician for committing a solecism in grammar.

The Rev. George Harvest, rector of Thames Ditton, was very absent-minded, so that on one occasion he went into a friend's house, and, seeing no servant, he rambled over it, finally entering the room of an old lady, ill of quinsy. He stumbled over a clothes-horse, and in his awkwardness made the patient burst into such a fit of laughter, that the quinsy broke, and she lived many years to thank him.

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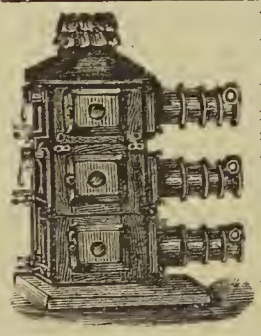

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SCIENCE NEWS & NOTES.

We trust our Readers

will not forget that all articles for our five-guinea prize competition must be sent in not later than December 1st. The subject is "The Condition of Man in 1991," and as every individual with a particle of intelligence has some views on this subject, we hope that every reader of SCIENCE SIFTINGS will compete. Remember that a few bright, intelligent lines are quite as competent to take the prize as a 2,000 word article?

What is Electricity?

This question is often asked, but, strange to say, rarely with a view of obtaining information. We asked it ourselves in our first issue, but still remain in ignorance. It is frequently used as a poser to floor some loquacious person who has been talking glibly on the subject. One who attempts to answer it seriously is looked upon as presumptuous. But we really know more about electricity than we do about gravity. Every day throughout this broad land school children are giving to their teachers what is considered to be the correct answer to the question, What is gravity? Yet the student who told his professor that he knew what electricity was but had forgotten, has become the butt of a very trite joke. Of the true nature of the mysterious force of gravity little is known.

Physical Science

has made unparalleled advances of late, but it still leaves us in the dark as to gravity. It is the same silent never-ending force which keeps the universe in balance. No one has ever been able to screen its attractive effect for even one single second. Go where you will, you cannot escape its force. It causes a stone to fall and a balloon to rise. It makes rain, rivers, and mountains, but of its exact nature we know infinitely less than we do of electricity.

Who has ever heard

of a wave of gravity, and who can tell the medium by which its power is transmitted from sun to earth? It has been proved that light and electricity are similar manifestations. Waves of light and electricity are now almost tangible everyday things. Electricity can be generated, propagated, and suppressed at will, but gravity goes on, always acting, never changing, and successfully defying the power of man.

Gravity

is now credited with many actions which were formerly accounted for in a manner which seemed quite as reasonable as our present explanations. The ordinary suction pump, it is now known, depends for its action upon the pressure exerted on a column of water by the air; but in the time of Aristotle it was explained by saying, "Nature abhors a vacuum." It was observed that space seemed always to be filled by matter, and the moment a solid body was removed its place would be filled by air or water. Thus. when the piston of a common pump was lifted, the water was caused to rise, and the explanation was all sufficient.

The Defect in this Theory

was only discovered in the seventeenth century. The Duke of Tuscany sank a very deep well, and notwithstanding the skill of his best engineers, the water would not rise in the pump much over thirty feet. Galileo, who was then near the close of his career, was appealed to, but he, after remarking that Nature did not abhor a vacuum over ten metres, referred the matter to his ablest pupil, Torricelli. The latter reasoned that if it were the weight of the air which sustained the water, that it ought to sustain a much shorter column of a heavier liquid like mercury. He accordingly inverted a long tube filled with mercury over a pan of that liquid, and found that the mercury fell until it came to rest at a height a little over thirty inches, leaving a vacuum at the top of the tube. This upset the Aristotlian doctrine that Nature abhors a vacuum and prepared the way for the law of gravitation.

Many of the Laws of Gravity

are known to us, but of the thing itself we know nothing. It may yet be proved that gravity is also an action propagated through the ether. It would thus come under the domain of electricity, which seems destined to absorb all

of the sciences. Perhaps, then, when the great secrets of nature are unlocked we may be able to suspend or screen its action at will. This would be a most stupendous triumph of electricity. Until the scoffer can tell what gravity is, let him not ask "What is electricity?"

Hypnotism,

according to Dr. Calderwood, the Professor of Moral Philosophy at Edinburgh, is merely a new name for mesmerism. The condition is one of artificially-induced sleep, which is, however, a lucid sleep. As regards the mode of producing the sleep, it is nothing in the nature of electricity or magnetism, and no influence emanates from the body of the operator. The result, Dr. Calderwood contends, is brought about by the wearying of a single organ or line of nerve. Many people are liable to it, but not against their will. The condition during the mesmeric sleep is torpor, the cataleptic state, or the state of the somnambulist. The professor wisely warns people against being mesmerised at all.

The Tragic Death

of Mr. Kunckel Herculais was chronicled by us in a recent issue. We said, *apropos* of the subject of locusts, that these ravenous little insects had been the cause of his end. We thank our numerous correspondents who have drawn our attention to a very pardonable error, for it appears that Mr. Herculais did not die in this way, or, as far as we can learn, in any other way. We apologise for killing him.

The Extinction of the Steam Engine,

in the opinion of Mr. Edison, is only a matter of a short time. He thinks that it will be displaced by his own newly-perfected motor electric systems, which he claims possess the advantages of economy, speed, and safety. Mr. Edison does not rely, however, on the fact that he can get a speed of a hundred miles an hour out of his motors, while steam strains itself at sixty, but on the fact that he can obtain one horse-power out of from one to two pounds of cheap coal, while out of six pounds of dear coal a locomotive engine can only get that same one horse-power. Electricity will displace steam, therefore, because it will be cheaper.

This Great Revolution

in motive power will be inaugurated to the World's Fair at Chicago, in 1893, and Mr. Edison randiosely fixes the date at 400 years after the discovery of America.

The Problem of Electric Locomotion

on what are now called steam railroads is a wonderfully simple one, claims Edison. The street car problem, however, was the poser. Any electrician, the inventor tells us, can run a train at high speed on a steam railroad track. This has always been the difficulty about establishing electric railroads in this country. We have never known how to adapt the existing tracks to the new principle of motion. Now that Mr. Edison is going to teach us how to do it, we shall have electric railways in no time.

The Details

of the construction of these wonderful electric roads have not been divulged by Mr. Edison, because he fears to injure his European rights, although he complains that he has never made anything out of patents on this side of the water. Mr. Edison goes as far as to tell us, however, that the electric current will pass from a stationary engine to a central rail between the tracks, thence through the mechanism attached to the bottom of the cars or motor. A freight train would need a motor because of the number of cars, although a single passenger car could be run carrying its own motor beneath it—thence to the wheels, and thence back by the side rails to the power house or stationary engine.

Three of these Stationary Engines,

with a horse-power of 10,000 or 12,000 each, would be sufficient for a pretty considerable line of railway, thinks Mr. Edison, and he particularly impresses on us, not only the economy of the system as between the stationary engine and the locomotive—one or two pounds of cheap coal will produce one horse-power in a stationary engine, and six pounds of dear coal are required for the same power in a locomotive—but the depreciation of the rolling stock and road bed will be much less. Every exertion of steam power is in the nature of an explosion, and when you take into consideration the fact that four or five hundred engines are on a road like the Pennsylvania at one time, each exercising a different degree of this explosive power, the depreciation is a great factor. But with electricity it is always the smooth, rotary motion, imparted in the same way by the same men at the stationary engines.

Two Hundred Miles an Hour

is the nice little speed at which Mr. Edison contemplates running his new electric service. The question may well be asked: Can any equipment be devised that will stand this terrific strain? But the wizard of Menlo Park, as the inventor is called, is quite confident about this, and as to stopping these lightning trains, he has provided air brakes for the purpose.

Street Vehicles

were found rather a more difficult matter by Mr. Edison, but he now considers that he has mastered all difficulties. The greatest difficulty was to obtain low speed to run four or five miles an hour, high speed can always be obtained. Again, the safety of the public was at stake, as an electric current running up and down the middle of a crowded street might take liberties with human life. We give Mr. Edison's own words in reply to an interviewer who gave expression to this fear. "A pressure," he said, "a little heavier than the one I use would make a horse lift his foot, so," and Mr. Edison raised one of his own feet about half an inch from the office floor, "but the pressure I do use, a horse wouldn't feel at all, nor would a man. You see, I employ the heavy current with the low pressure. That is the whole secret of safety. The principle is this, that a stream of water 100 feet wide which falls a foot gives the same power as a stream one foot wide which falls a hundred feet. The wide stream is my way, the high fall some other people's, and the allowance of such pressures in public streets as some that are used, is like letting a man place a boiler in a vault under a street and put on a thousand pounds of steam if he wants to do so. Electricity has developed too fast, you see, for the law to keep up with it. The whole question is one of expense. A low pressure trolley wire, for instance, requires four times as much copper as a high pressure one." Nevertheless, the new system will be "the cheapest known." We shall welcome its advent.

The Present Race

of ocean greyhounds, as it is the fashion to term the

Atlantic liners, admirable as they are, are not without their drawbacks,. A passenger can cross the ocean much more rapidly than he could a few years ago, but the chances are he will be a great deal more sea-sick. Such has not only been our own experience, but also that of nearly every old traveller with whom we have talked on the subject, and the officers of the steamers confirm it. There are two reasons for this. In the first place, since the general abandonment of auxiliary sail power, the vessels roll much more heavily than the old-fashioned steamers. When a sea came broadside on an old-fashioned steamer she would be held fairly steady by her sails, but the modern racers roll terribly. But worse than this is the vibration produced by the rapid revolutions of the twin screws. Even old sailors cannot stand this, and men who have been to sea all their lives have told us that the twin screws upset them. But at the worst, the agony of sea-sickness need never be endured but a short time, as the journey is so much speedier. We cannot say we place much reliance on the anti-sea-sick preparations, nor should we be tempted to try the glass of sea water, recently advocated—humorously, we trust—by a contemporary.

Three or Four Days

will be the extreme duration of the voyage between Europe and America some day, if we may rely on a statement lately made by Herr Carl Schurz, the President of the Hamburg-American Packet Company. This gentleman thinks that safety need not be sacrificed to great swiftness.

The Glacial Period

has been the subject of so much theorising, that it is very difficult to find an hypothesis with any novelty about it. This is the latest we have heard :—A terrestrial sphere, in passing from under the influence of interplanetary heat to the influcnee of solar heat, must experienee a glacial period, beeause of the remarkable properties under different degrees of heat and cold possessed by water. The earth was once a ball of fire. As it began to eool, a erust formed, and the air around the earth began to be cooled. This caused the aqueous vapour in the air to form water. But the internal heat of the planet was still intense, and an immense radiation of heat and a corresponding eondensation of vapour arising from the seas went on constantly. Solar heat had not yet penetrated the cold atmosphere between the sun and the earth. As the heat of the earth decreased, the condensation of vapour surrounding the earth as fog and cloud increased, until layer after layer of condensed vapour surrounded the planet. Suecessive iee shells were formed, and as the earth grew colder these iee shells eame nearer the earth, and finally shrunk down to it. Then the glacial period was on the earth. But the heat of the planet now ceasing to affect its crust, there was no more vapourising going on. All was ice and snow ; the mists and vapours were cleared away. Then the sun had a good chance, and it was not long before his rays pierced through the ether to the ice-bound earth. The ice began to melt, and the glacial period began to decline. When it was over, the earth's erust had passed under the influence of solar heat, and the seasons began.

Be Careful how you Laugh.

You may not suspeet it, but the very moment you are giving hearty vent to excited laughter, some audacious student of character may be taking a mental negative of your disposition. According to an ingenious French savant, persons who laugh with the sound of "a" in "father" are frank and loyal, fond of noise and movement, and frequently of a versatile and changeable eharaeter. Those who laugh with the sound of "a" in "ape" are phlegmatic, with a turn toward melancholia. The laugh in "e" is that of children and of adults who are simple, pliant, timid, and irresolute. The laugh in "o" signifies generosity and robust boldness. "Look out," says the French observer, "for those who laugh in "u," because they are the misanthropes."

A Wonderful Discovery

has been made by a native of Washington, D.C. (U.S.A.), which will revolutionise the hen coop of the world and turn mechanics into laying hens. A patent has been taken out for the manufacture of artificial eggs, and although we have heard of such things before, the present discovery is far in advanee of any of its predecessors. These eggs have been on view, and actually eaten boiled, fried, poached, and serambled, and nobody eould distinguish them from real ones. Externally they look exactly like the sort laid by hens. Break the shell of a raw speeimen and the contents flop into the glass in as natural a manner as possible, the yolk and white unmingled. It has been claimed that no imitation eggs could ever be be made to "beat up" for cakes, but these do perfeetly. The most important feature is, however, that ehemically speaking, these eggs are an exact reproduetion of nature. Corn meal is the basis of their material. The white is pure albumen, of eourse, while the yolk is a more eomplicated mixture of albumen and several other elements. Inside the shell is a lining of what looks somewhat like the delicate, filmy membrane formed by the hen, while the shell itself is stated to be made in two halves, stuek together so artfully that no eye can diseover the joining. The very germ of the chicken, with unneeessary faithfulness of imitation, as one might think, is counterfeited.

Wonderful Eggs

are these, and the correspondent who sends us the information says that for the purpose of gaining advertisement for these preparations, it has been suggested that the inventor may have conceived the plan of distributing real eggs in the guise of artifieial ones. This is certainly not the case, however, beeause there are points which render these artificial eggs distinguishable as such. For instanee, the lining is evidently made of some sort of silk-like tissue, and one ean see that it is woven. The shell is said to be cast in halves out of a lime composition, the lining being put in and filled and the two halves thereupon joined together. The eggs in their entirety are now purchasable at 10 cents (about fivepence) a dozen, but as they do not get rotten, they are sold, for cooking purposes, at a eheaper rate without the shell, the yolks and whites being put up in separate bottles.

Nicotine

is a much-abused poison, and often gets blamed for evils it does not effect. This is what a scientific smoker has to say on the subject :—"One never reads an advertisement eonnected with a tobacco pipe without seeing some reference to the removal of nicotine by meehanical means from the smoke which is taken into the mouth. It is a well-known faet that the British public will swallow any absurdity, if it be only offered in a tempting manner ; and the nicotine seare is one of the absurdities. Nicotine is a very volatile and poisonous alkaloid, one drop of which in a pure state will destroy human life. The largest quantity existing in any tobaeco is about 3 per cent. Of course it is not in the free state but in eombination as salt of an organie aeid. When the tobaeeo is burnt the nieotine is volatilised and passes off in

the smoke, some being destroyed in the process. The tarry liquid which settles in the stem of the pipe is not nicotine at all, but water, essential oil, and extractive matter. It is the oil which makes the smoker sick. While I am on this subject I may say that all patent pipes containing obstructions in the form of clay cylinders, portions of sponge, etc., etc., included in the cavity of the stem are a great mistake, and only intensify the evil they are supposed to prevent. What is wanted in a pipe is a wide bore which can be easily cleaned, and all old smokers will tell you the same thing." We are not surprised that even those who do not get sick when smoking become nauseated with the terrible stories perpetrated on them by pipe manufacturers.

Terrestrial Magnetism

results, Prof. Frank H. Bigelow believes, from solar energy transmitted to the earth upon two sets of lines; one the coronal, curved, and crossing the plane of the ecliptic perpendicularly; the other, straight, like the rays of light and heat, and parallel with the ecliptic. The latter set he holds to be the most important, at least as regards the daily oscillation of the needle. What takes place every day, then, as the earth rotates in these rays, is practically what takes place in a dynamo for producing electricity. It is only necessary to move any conducting substance past a magnet, across its lines of force, in order to have that conductor made a magnet itself for the time being by induction, and for a system of electrical currents circulating round its axis to be excited. While the conductor approaches its nearest end, it acquires, say north-pole magnetism, and the surrounding currents go in one direction, counter-clock-wise; but when the moving conductor has passed the stationary magnet, this nearest end, now receding, reverses its polarity, and becomes a south pole.

In a Dynamo

there are scores of such conductors arranged on a circular rotating frame, which are thus brought in succession towards and away from the dominating magnets. Professor Bigelow conceives that each spot on the earth's surface is rotated daily past the sun, and goes through this same experience. From dawn to noon it approaches: from noon to sunset it recedes. The various instruments in an observatory registering the various components of the magnetic situation induced immediately underneath them, swing first in one direction and then in the other, and when they are carried out of sight of the sun at night come to a state of rest, provided, of course, that no exterior disturbance arises. Were the earth stationary, this radiant influence would be felt instantaneously, but owing to its rotation there is a lag of about 23° of longitude, or about an hour and a half of time. Along these radiating lines light and heat pass outward from the sun; the magnetic force is directed inward.

Increased Rainfall,

we suggested in a recent issue, had resulted in the vicinity of Paris, since the erection of the Eiffel Tower, due to the amount of atmospheric electricity attracted by this structure. A correspondent, Mr. J. Christian, considers that this suggestion is pregnant with larger meaning than at first appears. For, if the projection of a small tower into an atmosphere forty miles high has sensibly affected the rainfall in its vicinity, what effects ought we reasonably to expect from girdles of electric wires over large tracts of land on the surface of the globe and underneath even the waters thereof? Put a stone six inches diameter on the edge of a tiny mountain-side rivulet, and what is the result? A diversion of the little stream and the ploughing up of a new channel. Run a stone breakwater a mile out to sea from Brighton or a point of the sea coast in the French and English Channel, and what result? Clearly a diversion of the tidal current and a sweeping away of land somewhere in the neighbourhood. In like manner keep constantly stirring up and disturbing the electricity under, on, or near the earth's surface, and what result? Surely a disturbance of the subtle and comparatively unknown powerful agent—electricity—in nature at rest.

Do you wonder

now, asks Mr. Christian, at the curious weathers experienced in the last decade? Your electric operations have interfered with a law governing Earth, and you must expect consequences, as from the breaking of any laws physical, moral, or divine. But you have also interfered in another way, undreamt of, too, by the ancients—you have been pumping millions of gallons of petroleum out of the earth, creating a vacuum, which Nature abhors. That vacuum must be filled. During the latter gradual but certain process, coupled with the constant electrical disturbance, do you expect Mother Nature to remain at rest, carrying on her usual beneficial operations for man and beast? Think of it, philosophers; and after coming to the conclusion that all this is humbug, pray tell me what would be the result were the Almighty to put his little finger on one of the vent-holes of Mother Nature, say Vesuvius? Would the Apostle's "dissolving of the elements themselves" be a remarkable thing?

Insuring the Lives of Cattle

is very common in America, but those offices which issue such policies have just come to the conclusion that a distinct increase in the risk is caused by the use of wire fences on farms. The number of cattle reported as killed by lightning is very large. "Most of the animals," says a writer in the State of New York, "were near wire fences at the time, and it is supposed that the metal strands act as a conductor of electricity in a degree sufficient largely to increase the risks."

The Term "Weed"

is a relative one, and has been defined to mean only plants that are able to assert their inborn rights above all others and wage a close warfare with man for the possession of the earth. There is nothing in structure, form, or substance that distinguishes a weed from other plants. It lives, grows, and reproduces its kind like all others of its class, and therefore the methods of migration are the same as obtain with those of its kin. The rapidity may be greater because of the dominant weed nature, but the difference is only in degree and not in kind. A large number of our worst weeds come to us from foreign countries: just how they emigrated will never be known in every case. Some came as legitimate freight; many were stowaways. Some entered from border lands upon the wings of the wind, upon river bosoms, in the stomachs of migrating birds, clinging to the hair of passing animals, and a hundred other ways, besides by man himself. Weeds, usually as weeds, go and come in all directions, no less as tramps catching a ride upon each passing train, than in cherished bouquets gathered by the wayside and tenderly cared for by tourists and others.

Prizes for Everybody on Page 94

THE PRIZE SCIENCE SIFTING.

One Guinea will be paid each week to the contributor of the most interesting or curious Science paragraph.

The paragraph must not exceed 200 words, and need not be original, but in this case, the source from whence it is copied must be given. All paragraphs must reach us on Monday, and be marked "Prize Science Sifting" on the envelope, unless a postcard be used. Only one paragraph may be sent in by each competitor.

The Editor reserves the right of publishing any paragraphs sent in.

We have awarded the prize of One Guinea to Mr. Arthur Woodward, 12, Achilles Road, West Hampstead, for the leading "Science Sifting." The other siftings published all deserve honourable mention.

Stray Electricity.

Everyone is struck with the apparently singular fact that iron railings, when fixed into stonework by means of lead, rapidly become eaten away at the bottom. Few, however, are aware that this phenomenon is entirely due to the agency of electricity. Every chimney pours sulphur di-oxide into the atmosphere, which becomes further oxidised by the air and is eventually washed down in the rain as sulphuric acid. This finds lodgment at the base of every such rail, and not being volatile, becomes concentrated by the evaporation of the moisture. Here we have all the conditions of a miniature voltaic cell. An electric current is set up from iron to lead ; the iron is torn away by the current and deposited loosely on the lead, the next shower of rain washes it away, and the streaks of iron rust may be seen on the stone. That this is not due to the mere solvent action of the acid, is proved by the fact that no such corrosion is seen at other places on the rail. Hence, it is important that outdoor ironwork should be fixed by other means than molten lead.

Spiders of the Gloom.

It is not an uncommon experience in entering some cellar, or little-used closet, to find oneself in an unpleasant mass of spider's web, and a natural reflection is, why should spiders construct webs in such places, where they can have so few chances of catching flies or other winged insects ? The magnitude of these webs is in some cases remarkable, and it would seem that they must furnish homes or snares for the use of successive generations of spiders, the new comers enlarging or expanding the webs of their ancestors. Some people, indeed, have thought that these cellar-webs are merely abodes, not intended as traps, and that the spiders belonging to them go out hunting elsewhere, and return to these from time to time. But the hunting spiders do not spin, except an egg-bag. I have reason for thinking, that the food spiders do get from these webs is not yielded by flying insects, but by tiny crawling species which like damp and dark places.

J. R. S. Clifford, 82, *Marion-villas, Gravesend, Kent.*

Explosive Ice.

A most unusual phenomenon, which occurred in the laboratory of the University of Virginia, has been described by Mr. Mallet, the Professor of chemistry of that establishment. During a severe storm, ice was found in the glass vessel of a gazogene, the familiar apparatus for charging water with carbonic acid gas. The expansion of the ice burst the vessel, after which the ice itself exploded repeatedly, and threw off fragments with a crackling sound. The effect is attributed to the pressure of the gas contained in the ice, which, in the case of water, would appear as simple effervesence.

Arthur Wm. Lee, 11, *Colva-street, Dartmouth Park Hill, Highgate, N.*

Waste of Force.

Speaking of the waste of tidal power in the river Severn, Professor Sylvanus Thompson says:—"The average rise and fall of the tide at the city of Bristol, five miles from its mouth, is twenty-three feet. According to calculations made from the average volume of water displaced up and down each tide, there are no fewer than twenty billion foot-pounds of energy wasted each year, or enough to charge ten million Faure cells. At the mouth of the river the total annual energy thus running to utter waste cannot be less than fifty billion foot-pounds. Thus in the rapid currents of the river Severn, with their enormous tides of great volume, the tidal energy must be practically unlimited. A tenth part of this energy in the gorge of the Avon would light the city of Bristol, a tenth part in the channel of the Severn, would light every city ; and another tenth part would turn every loom and spindle and axle in Great Britain."

G. Bull, 2, *Derby-street, Leek, Staffs.*

On Rain Making.

You say you do not understand why a noise should cause rain. Well, if I may be allowed to say, noise certainly does not do it, but the rush of air if continued does. The natural cause of rain is depression, or not sufficient recovery of air to balance a certain amount of cloud. Our atmosphere is simply hills, valleys, and holes of different sizes and shapes, and the clouds are continually sliding down these until a certain balance is effected, when the rain at once stops. Now, knowing that the clouds are balanced by air underneath, if that air is blown away by immense explosions, the weight of the cloud being greater than the air left, it must naturally descend, and if sufficient air be displaced so as to bring this cloud within the attraction of terra firma, it will fall, unfortunately, not as rain, but simply descend as a torrent. I do not know whether you have ever taken the trouble to notice this on a small scale at the Crystal Palace, just as the fireworks commenced. It is quite common, usually about September, when clouds are just evenly balanced by air underneath, so as not to be attracted by terra firma. Now, when the first Maroon is sent up you will see it disappear in the cloud, and it explodes *above it*, and immediately very fine misty rain will commence falling in the Palace *grounds only*, and continues until finish of display, when it ceases.

E. Kennedy, 16, *Eversleigh-road, Lavendar-hill, S.W.*

The Ant's Home.

The ant-hill, the residence of a colony of ants, is a wonderful construction made of earth. It is about the size and form of a washing basin turned upside down, and contains within it innumerable chambers and galleries, made by the energy and industry of its little inhabitants. If a small piece of this house be broken, and the interior examined, it presents a scene of wondrous activity. Some ants rush hither and thither ; some seize the eggs which have been exposed and hurry with them to a place of safety, and others apply themselves to repairing the breach. While thus engaged, the ants, on meeting, are often observed to stop, and touching each other with their antennæ, apparently have the power of communicating their ideas.

Albert Edward Craven, 5, *Ceder-mount, Armley, Leeds.*

GLEANINGS OF THE GLOBE.

THERE are two hundred and forty-six bones in the human body.

THE sense of touch is fullest developed in the tips of the fingers and the tongue.

CATERPILLARS in the course of one month devour 60,000 times their own weight in food.

PERSONS in the Aretic regions are able to converse more than a mile apart.

THE weight of blood in the adult human body averages from twenty-five to thirty-five pounds.

THE pressure of the sea at the depth of 1,100 yards is equal to 15,000 lbs. to the square inch.

ICE of sufficient hardness and density can be and has been formed into cannons and fired more than once without bursting.

IT is estimated that a single pair of sparrows and their young ones, consume upwards of three thousand insects in one week.

HYDROGEN or coal gas may be detected by persons of acute smell when there is one part of gas in every five hundred parts of atmospheric air.

THE horse chestnut may be rendered edible by removing the acrid juice by a chemical process, which is, however, too expensive at present to be of commercial value.

IN consequence of the failing health of Professor J. H. Pepper, the whole of his dissolving view apparatus is for disposal by Mr. Walter Lawley, of 78, Farringdon-street.

FEW persons are aware of the existence of lunar rainbows. Yet this phenomenon in nature sometimes takes place in northern latitudes, and is caused by the light of the moon falling upon rain. Lunar rainbows are seldom coloured.

THE British Museum has among its treasures an almanac three thousand years old. The days are written in red ink on papyrus, in columns, and under each is a figure, followed by three characters, signifying the probable state of the weather for that day.

THE blacks of Senegambia cool water by filling tanned leather bags with it, which they hang up in the sun; the water oozes through the leather so as to keep the outward surface wet, which by its quick and continued evaporation cools the water remarkably.

A PHOTOPHONE is an instrument for transmitting speech by means of a beam of light. You speak against a thin mirror, causing it to vibrate; the light from the mirror is reflected and focused upon electrified selenium, which is sensitive to the light vibrations; and when a telephone is connected with such selenium, sounds are heard.

THE most valuable fur in the world is that from the belly of the Russian silver fox. The colour is black, with here and there a tip of silver. This fur is used exclusively for linings, and though exceedingly warm, is so light that the material for a whole coat or cloak weighs but a few ounces. The back fur of the silver fox is also valuable, but is used for trimmings and outside wear.

THERE are not quite six months of darkness at the poles. Although the sun is absent for that length of time, it is near enough to the horizon for several weeks after the night begins and for several weeks before the day opens to produce twilight. The darkness is not dense enough to render the stars visible for more than four months out of the six. It is night now at the North Pole, and it is day at the South Pole.

LIGHTNING has been proved to have struck a church with a force equal to more than 12,000 horse-power. A single horse-power in mechanical calculations is equivalent to raising a weight of 33,000 lbs. one foot in a minute. The force of lightning has therefore been proved to be equal to the raising of 396,000,000 lbs. one foot in a minute. The power of a draught horse, of average strength, working an average of eight hours a day, is however, only about four-fifths of a standard horse-power.

IT is said tobacco injures the voice. Sir Morell Mackenzie emphatically condemned its use and the use of alcohol by singers and public speakers. But Dr. Lennox Browne, an authority on throat diseases, is less dogmatic. Still even he holds that tobacco can effect no good purpose, and that it is capable of inflicting injury. In order, however, to test the matter from the standpoint of experience, he addressed this question to 383 singers: "Are you in the habit of smoking tobacco?" Nearly one-half of them answered "Yes." Thirty-nine answered "Occasionally," thirty-three answered "In great moderation," and 118, or not quite one-third of the entire number, gave a direct negative.

THE Supreme Counsel of Hygiene of Austria has been engaged in discussing the advantages of erect as compared with slanting writing, and the official reports of Drs. von Reuss and Lorenz points strongly in favour of the former. They point out that the direction of the written characters has a marked influence on the position of the body. In "straight" writing the scholar faces his work and is spared the twist of the body and neck, which is always observable in those who write slantwise, and one common cause of spinal curvature is thus obviated. The erect method is, therefore, expressly recommended for use in schools in preference to the ordinary sloping lines.

AN amusement novelty of the Frankfort Electrical Exhibition was arranged in triangles, having similar boundaries—a pair of pillars and a sort of Byzantine arch—and each offering standing room for two or three persons. Some of the sides were left open, others were filled with carefully cleaned looking-glass. The whole was covered with white cloth, through which a uniform top lighting was obtained from either daylight or electric arcs. The effect was indescribable, a peculiar nervous state being usually occasioned, in which the visitor hardly dared to move. The main goal was a brilliantly lighted chamber, where distorting mirrors produced most comical appearances, while a triangular room overhead was lined with mirrors which showed the ten or twelve visitors as a countless multitude.

WHAT ARE DREAMS?

"KNOWEST thou what thou art in the hour of sleep?" This query is not easily answered. Sleep has been defined as the intermediate state between wakefulness and death—between the active state of all the animal and intellectual functions and their total suspension. It is maintained by some learned writer's that the senses fall asleep in succession: first the sight, next the taste, then the sense of smelling, then the hearing, and last the sense of touch. The same writers have advanced the opinion that the senses sleep with different degrees of soundness, and that the senses of taste and smelling awake last, the sight less readily than the hearing, and the touch the easiest of all, as it is the last to fall asleep.

There is a mystery about sleep which never has been, and probably never can be, satisfactorily explained. Some physiologists hold that complete sleep is a tempoporary metaphysical death, although not, of course, an organic one—that in it the heart and lungs perform their offices with their accustomed regularity, and that it is characterised by a torpor of the organs of the brain, of the external senses, and of voluntary motion; while incomplete sleep is the activity of one or more of the cerebral organs while the others are in repose.

We write, however, not so much for the purpose of considering the philosophy of sleep as to speak of the operations of the mind in dreams.

To-day, as in the earliest ages, many persons regard dreams as a dim prevision of coming events. Artemidorous defines a dream as "a motion or ficton of the soul in a diverse form, signifying either good or evil to come;" and Porphyry ascribed dreams to "the influence of a good demon, who thereby warns us of the evils which another and bad demon is preparing for us."

To the question. What are dreams? the answer is. They are our mental states and operations while we are asleep, and they are fashioned from the materials of the thoughts which we have while awake—from the slight bodily sensations of which we are susceptible in sleep. The state of health also has considerable influence, not only in producing them, but in giving them a particular character.

It is a remarkable fact that not infrequently, when the powers of the body are utterly suspended, the intellect exhibits an increased and more exalted energy. Condorcet's experience is often adduced on this point. While engaged in abstruse and profound calculations, he was frequently obliged to leave them in an unfinished state in order to retire to rest, and he says that the remaining steps and the conclusions of his calculations have more than once presented themselves in his dreams. Similar proof comes from Condillac, who tells us that when engaged in his "Cours d'Etude" he frequently developed and finished a subject in his dreams which he had broken off before retiring to rest. So, likewise, Coleridge relates of himself that his fragment, "Kubla Khan," was composed during sleep which had come upon him while reading the passage in Purcha's "Pilgrimage" on which the poetical description was founded, and was written immediately on awakening.

Carlyle relates that, when "a very little thing," anxious to learn, Jane Welch, who afterward became his wife, would sit up half the night over her lessons. One day she had been greatly perplexed by a problem in Euclid which she could not solve. At last she went to bed, and in a dream got up and did it, and went to bed again. In the meantime she had no consciousness of her dream, but on looking at her slate, there was the problem solved.

It is a well-attested fact that our dreams are sometimes caused by our sensations. It is related of an English soldier that, so susceptible was he to audible impressions while asleep, his companions could make him dream what they pleased. They amused themselves by leading him in his dreams into some frightful difficulty, and watching his efforts to extricate himself—sometimes inducing him to believe that a shark was in close pursuit of him; at others, that he was suspended only by a thread from the projecting cliffs of a fearful precipice; and again that he had given offence to some person and must fight a duel. Thus, on one occasion, they caused him to go through the whole process of a duel from the preliminary arrangements to the firing of the pistol, which they put into his hands, and the report of which awoke him.

Unpleasant dreams are generally produced from the mind being in a troubled state on account of ill-health or some other cause. While, as we all probably know from experience, the sensation of being wafted through the air in our dreams is enrapturing, that of suddenly falling from a great height is so painful that we always wake before reaching the ground. Nightmare is usually, if not invariably, preceded by a frightful dream of some description: and these hideous visions are as various as are the conditions of those who experience them. Instances are related of persons who, after having been dumb for years, have recovered their speech by their struggles and finally successful efforts to call for aid while in their sleep, imagining themselves in imminent danger. So, also, frightful dreams have been known to produce insanity.

It may be regarded as a singular fact—and physiologists assure us that it is a fact—that a person, deaf and dumb from birth, never dreams of conversing except by signs or in writing: and that one blind from birth never dreams of visible objects. We have it from the same authority, borne out doubtless by general experience, that "while the imagination cannot supply the place of real memory, it has the wild faculty of counterfeiting memory. It dreams of persons it never knew, and talks with them as old acquaintances. It relates circumstances that never happened, and tells them as if they had happened. It goes to places that never existed, and knows where all the streets and houses are as if it had been there before. The scenes it creates often appear as scenes remembered. It will sometimes act a dream within a dream, and in the delusion of dreaming tell a dream it never dreamed, and tell it as if it were from memory." Says Coleridge:

> You stood before me like a thought,
> A dream remembered in a dream.

Who, when partially awakened from a half-finished pleasant dream, has not striven to court sleep in the vain effort to again enter into its agreeable sensations and to realise its completion? This is no uncommon thing. We have often thought what a curious jumble it would make were we to write out a full description of our nightly visions, as Archbishop Laud used to do, and yet, who knows but that many, if not most of them, would admit of a plausible interpretation? For the time being they appear to be real, and as our waking dreams are never without some object, why, if we remember the dreams we have when asleep, may we not inquire their meaning?

A lunacy doctor gives a number of examples showing, as it would seem, that there is a great similarity between insanity and the state of dreaming. He observes that testimony is frequently given by those who have recovered from insanity, that the whole period of their disease now appears to them as a dream—sometimes happy, but oftener painful and gloomy. Thus, he thinks, it is seen that the sane mind

approaches nearest the insane state during dreamy sleep.

Our estimate of time in dreaming is not the least remarkable feature of dreams. In the space of a few moments we dream of performing labours which in reality would require months, if not years, to accomplish. Long journeys are taken, and weeks, perhaps months, of agreeable pastime experienced with our friends, some of them perhaps long since dead, and all in the slumber of an hour, or perhaps of a few moments. It is equally remarkable that we go through such experiences, or nightly visions, without there seeming to be, anything at all wonderful in them, or that they are in the least degree impossible. Another strange thing about dreams is that they often appear to be occasioned by impressions made upon the brain many years before.

We often hear the question asked, "Do you believe in dreams?" and sometimes the answer is in the affirmative. Wieland, in his fairy tales of *Oberon*, says :

The best to do with dreams is, always give the lie
To what looks dark in them, and only keep the fair.

While we must acknowledge the wisdom of the Scripture saying that, "Whoso regardeth dreams is like him that catcheth at a shadow and followeth after the wind," we must at the same time admit that events sometimes appear to be clearly foreshadowed by our nightly visions. Of this unnumbered instances might be given ; we will give only a couple.

A gentleman in Scotland had an important case pending in court. He was fully impressed with the belief that his father, who had been many years dead, was, while living, possessed of evidence which, if produced, would turn the case in his favour ; but he searched in vain for it among his father's papers, and had nearly given up all hope of success when one night he dreamed his father came and directed him to a person at a distance, in whose hands he had deposited the desired papers. He rose in the morning, went to the place designated, found the papers and thereby gained his case.

In this connection the relation of President Lincoln's well-known and most remarkable dream seems appropriate. It is given in one of Charles Dickens' letters from Washington, as having been told to him by the late Edwin M Stanton. On the afternoon of the day on which the President was shot, there was a Cabinet meeting, at which Mr. Lincoln presided. Mr. Stanton was late, and on his entering the room the President broke off in something he was saying, and remarked : "Let us proceed to business, gentlemen." Mr Stanton then noticed with great surprise that the President sat with an air of dignity in his chair, instead of lolling about in ungainly attitudes, as his custom was, and that instead of telling irrelevant stories he was grave and calm, and quite a different man. Mr. Stanton, on leaving the council with the Attorney General, said to him : "That is the most satisfactory Cabinet meeting I have attended for many a long day. What an extraordinary change in Mr. Lincoln!" The Attorney General replied, "We all saw that before you came in. While he was waiting for you he said : 'Gentlemen, something very extraordinary is going to happen, and that very soon.'" To which the Attorney General had observed, "Something good, sir, I hope," when the President answered very gravely, "I don't know ; I don't know ; but it will happen, and shortly, too." As they were all impressed with his manner, the Attorney General took him up again. "Have you received any information, sir, not yet disclosed to us?" "No," answered the President, "but I have had a dream ; and I have now had the same dream three times—once on the night preceding the battle of Bull Run, once on the night preceding such another"—naming a battle also not favourable to the North. His chin sunk on his breast again, and he sat reflecting. "Might one ask the nature of this dream, sir?" said the Attorney General. "Well," replied the President, without lifting his head or changing his attitude, "I am on a great, broad, rolling river, and I am in a boat, and I drift, and I drift—but this is not business"—suddenly raising his face and looking round the table as Mr. Stanton entered. "Let us proceed to business, gentlemen." Mr. Stanton and the Attorney General said, as they walked on together, that it would be curious to notice whether anything ensued on this, and they agreed to notice. He was shot that night.

SIFTINGS OF THE STUDY.

"Health Troubles of City Life."

By George Herschell, M.D., London. (*Swan Sonnenschien.*)

All the toilers in that great human mill, the City, will appreciate the title of this little book, and we warrant that they will also appreciate the book itself on perusal, and our advice to all those who have a just appreciation for their own well-being is to peruse it. It abounds with so much logical and philosophical advice in so small a compass, that it may be read without effort, and the reading is calculated to lift the reader out of the state of a mere living machine, always liable to stoppages and breakdowns, into a forceful and intelligent piece of mechanism, extracting twice the enjoyment out of life that it has hitherto done. And all this without any sacrifice. Dr. Herschell merely shows men how to live under hygienic conditions, and how to perform the greatest amount of work with the least amount of physical and nervous strain. In short, he tells us how to work, live, and be happy, as opposed to the almost universal system of toiling in slavery and misery. "The most important of all rules of health for the man of business is to strictly confine his work to the proper time and place," says the author. The failure to do this is half the cause of the "Health Troubles of City Life."

Indigestion.

By George Herschell, M.D., London. (*Bailliere, Tindall, & Cox.*)

The subject of indigestion has been fruitful in treatises, but we do not remember perusing any that could compare with Dr. Herschell's book for comprehensiveness and simplicity. It is written with a view to meet the requirements of both medical and lay students, and well it performs its mission. The author shows us both cause and cure, and indicates the symptons by which every specific form of that hydra-headed disease, indigestion, may be detected. Many of us suffer from weariness and weakness, without any more pronounced symptoms. We have dyspepsia, and fail to recognise the complaint, or else take tonics—alcohol and drugs—to try and whip our systems into greater activity. We venture to think that a glance at the pages of Dr. Herschell's book would prevent many from following this irrational and suicidal course. We regret that our limited space will not permit our quoting extensively from the pages of this work, but we would draw our readers special attention to what the author has to say about imperfect mastication of food, active bodily exercise just before or just after a meal, excess of and insufficient food, improper arrangement of meals, injudicious mixture of foods, and above all, excessive and improper use of jams. These are only a few of the subjects touched upon, for the book is thorough. We say read it, because it is *not* calculated to teach anything to the lay reader that is unnecessary to be known, and it *is* calculated to make life more livable.

DELIRIUM TREMENS.

There are many popular errors concerning the disease called delirium tremens, and comparatively little actual knowledge of its direct cause, what it consists of, the proper method of treatment, and its cure. Mania-a-potu and delirium tremens, by the public in general, are supposed to be one and the same disease, when, in fact, they bear but slight resemblance Even the medical fraternity are lamentably ignorant upon the subject, and few, indeed, have a just conception of the disease or the proper method of treatment to be pursued.

Mania-a-potu bears about the same resemblance to delirium tremens as does a severe cold to a fever; or, in other words, the difference between the two is the difference between imagination and reality. In the former the victim has hallucinations, sees strange sights, and hears people talking to and about him, all of which imaginary ideas he can be reasoned out of; but when the latter condition obtains then everything becomes a reality, and all the powers this side of eternity cannot convince him to the contrary, and it is not good policy to make the attempt, as it only aggravates the patient.

Another very prevalent error lies in considering a person with the tremens a dangerous maniac. It is true that delirium tremens is one of the many forms of insanity for the time it exists: but the victim is in no manner dangerous to others. He is in constant fear; some trouble or danger threatens him at every point, and his chief desire is to escape, not by injuring some one, but to get away from surrounding perils. Sometimes his earthly career is to be cut short by poison, and he will refuse food, drink or medicine. Again, he is to be cut into pieces with knives, and he will beg piteously for some more speedy form of death. In fact, death in some form threatens him on every hand.

Although it is admitted that delirium tremens is a form of insanity produced by excessive alcoholic indulgence, it differs from a pure case in that—during the time the former continues—the person will remember distinctly everything he heard or saw (in imagination) and recognise those with whom he is acquainted, and also remember actual conversation, while in the latter case the period of insanity is a total blank, whether it be for one week, one year or more. Medical authority and the statistics of various inebriate asylums will bear out this statement.

Another error often emanates from so-called temperance lecturers, who either from ignorance or desire to create profound horror, have depicted a man dying from the tremens continually "screaming for rum." Records cannot be produced to attest such a statement. As a matter of fact, a person will often quit drinking when the delirium commences, without knowing he is in that condition. In an actual case he never realises that he is delirious. He imagines himself all right and every one else wrong. Another error lies in the supposition by many that a person always dies from the third attack. With proper treatment he may pass through many, and finally die from old age. Again, the idea is entertained, and even by some physicians, that a complete withdrawal of alcoholic stimulants from an excessive drinker is liable to produce delirium. On the contrary, when the system becomes impregnated to a certain degree with alcoholic poison, delirium will supervene whether the habit be continued or not. To continue drinking, or even to partake of alcohol at all, is merely to add fuel to fire, or poison to poison.

While there is no danger to be feared from a person in delirium tremens, there is great danger to the sufferer if not under complete restraint, and a person may be thus afflicted for days or even weeks before the disease is recognised as such, and many cases of suicide may be attributed to this cause. We remember a case of a physician of good standing in the community, who, while suffering from the disease and an inmate of an institution, called for his surgical case, and when asked for what purpose, answered that his abdomen was full of small snakes, and he explained the manner in which he proposed to perform a surgical operation on himself to dislodge them. Had he been at home, undoubtedly a suicide would have been recorded in the paper—cause unknown. Another person, after being pursued by demons of every description, and threatened with death in many forms, was told by an immense fish that swam into his room that by taking a certain preparation he would be enabled to live under water, and so escape all persecutions. If the victim had been at liberty he might have tried the experiment. Who knows but what many of the cases reported as accidental drowning have not resulted from delirium tremens.

Perhaps no better idea of what the disease consists of can be given than by relating a well-authenticated personal experience, which was as follows:—After a protracted debauch the patient landed in an institution for the cure of inebriety, and was assigned a room in the hospital department, where in a few hours his trouble commenced. He was continually seeing shadows of pictures on the walls. Faces, some angry and distorted, others very beautiful, would appear. At times he would see some wild animal gazing at him through the window. These made no noise, but there were invisible people who persisted in talking to him, sometimes giving him friendly advice, and at others using the vilest epithets and threatening him with some fearful punishment unless he "went away;" but that he could not do, nor did he then care to; for he realised that all this confusion existed only in imagination, although he would forget himself sometimes and answer back occasionally, and then laugh at himself for it afterwards. This state of affairs continued for two days, and then changed from mania-a-potu to delirium tremens, or from imagination to reality. That is (and this is where the line of demarcation may be drawn), he knew it was imagination before. After the change from the first to the second stage of the disease, he was really sure that everything he saw or heard was real, and no one could make him believe differently.

The change came about almost instantaneously, and in the following manner:—He was lying on the bed, and distinctly heard the physician in charge talking with a policeman concerning him, by which he learned that he was there under observation, and in a few days was to be sent to an insane asylum. The doctor told the officer when to come for him. He also told the attendants to keep a sharp watch upon him. The patient opened his door and looked out into the corridor, but, of course, no one was visible. He called an attendant and asked him about the matter, but he denied any knowledge of the matter, as did also the physician a few minutes afterwards. He insisted that it was a fact just the same, and, could he have done so, he would have made his escape, even though in nearly a nude condition. To guard against any such contingency he was placed in a room, the window and door of which were grated, and here his real torment commenced.

To describe all the poor wretch passed through would make a large book. The scenes were constantly changing from one extreme to another. Sometimes it would be pic-

tures whose beauty would defy the most noted artists to reproduce—beautiful women in resplendent dress, who, like the dissolving views of the optical lantern, would change to women in a nude state. Again, his parents (who had been dead for years) were being murdered, and he demanded his clothing and liberty that he might protect them, and swore like a pirate when he was refused. He claimed there was nothing the matter with him, that those who had locked him in were crazy, if anyone, and that he was unjustly detained; but he could not make them believe it. In the twinkling of an eye the scene was again changed, and he was surrounded by venomous reptiles of all sizes and kinds, and by dangerous animals of every known and many unknown species, and whose number would test the capacity of the proverbial Noah's Ark and the descriptive ability of a Dante.

Thus it continued, ever changing from one scene of horror to another, and these sights were living, moving objects and beings. At one time former acquaintances were boring holes through the wall through which to shoot him, and to guard against that he crawled under the mattress. They then decided that as they could not shoot through that, they would set it on fire and cremate him, and he screamed "Help! Murder! Fire!" as loudly as he could. The next minute he had a new trouble. Small doors in the side of the room would open, through which came troops of small animals of a strange kind. Some seemed to be playful and harmless. Others were not so, and he was obliged to be very active to keep out of their reach. Again, he had exposed the secrets of some order, and a delegation visited him and gave him a choice of the manner of death; but he compromised with them by joining the order. Rats and snakes by the million, animals of every known species, and thousands that no one ever saw but himself, besides many people to injure him in some way, were present with him in a room about 10 feet square, but which at times seemed as extensive as a large hall; and here he remained in this living hell for two days and nights, until the proper time arrived, and he was given a dose that sent him to sleep most of the time for the next thirty-six hours, after which reason resumed her throne, and he was cured. Imagine yourself in a "nightmare" lasting two days and nights, and you have some idea of delirium tremens.

Prizes for Everybody on Page 94.

A QUEER ILLUSION.

A QUEER optical illusion will be noticed by anyone who makes the experiment of turning upside down a letter or figure, the upper part of which is apparently exactly of the same size and shape as the lower. If you look at an S, for instance, or an X, you will at once say that there is no difference in size between the upper half and the lower, but turn them upside down, and the disproportion becomes strikingly apparent. The same thing is true in the figure 3, or the figure 8. There is an apparent tendency in the eye to exaggerate the smaller upper portion, and thus to make it appear of the same size as the lower half. That this is the case can easily be proved, for if you make an X with the upper half just as large as the lower, it will look top heavy.

IF the heat received by day were not radiated back by night, the earth, acquiring an addition of heat every day, would soon become so hot as to be unendurable by the vegetable and animal kingdoms now existing upon it.

PHRENOLOGY EXPLAINED.

BY STACKPOOL E. O'DELL.

Author of "Phrenology: its Truthfulness and Usefulness," "Old St. Margaret's," "Merciful or Merciless?" "Brompton Lectures," "Mental Troubles," etc.

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VI.

The organ of order is situated between those of colour and calculation, on the outer ridge of the eyebrows. In accordance with its size and activity, it denotes a desire to have things in order, in their appointed place and position. It does not follow as a necessity that the prominence of this faculty will cause the individual to make any great effort for the purpose of keeping things orderly, that will depend upon the temperament and the activity of other faculties. It is oftentimes the case that an individual will admire order, as, in fact, most individuals do, but will be thoroughly disorderly in some one or more directions; but when this organ is above the average, when it approaches large or very large, we expect to find that a great and constant effort will be made to keep things in their place, as well as a general appreciation of order. That this is a distinct faculty of the mind, having an individuality of its own, is clearly proved to us by the fact that there are men who possess the most exquisite taste in many directions and are cultivated admirers of all that we hold to be beautiful, with the exception of the beauty of order. In regard to this, some seem to be indifferent, while others, although they may admire order and censure those who do not keep it, will make no effort to keep it themselves. The usefulness of this faculty cannot but be acknowledged, and cannot be too highly appreciated. It enters into our own personal and domestic life, as well as all business, commercial and national transactions. The orderly and systematic arrangement of things, whether it be in the house or in the nation, should be a matter of pleasure, not much inferior to that given to us by the faculties of colour and tune. This will be the case when the faculty is cultivated in combination with its natural activity. Women have this faculty larger than men, more especially in regard to household matters, because they have been trained to look after these things, and very soon their trained eyes perceive things out of place in a house, to which disorder many men would be blind. Where it is excessively large, like all the other faculties, it results in pain instead of pleasure. The eye is never satisfied, there is constant arrangement and rearrangement; and if anything is in the slightest degree out of place, there is a feeling of dissatisfaction that interferes much with enjoyment. The lives of some women are a burden to them because of the excessive activity of this faculty. Yes, and they make the lives of others a burden too. They are constantly changing their domestics, who to their minds, are "streelish" and disorderly, although they may have an average amount of the faculty. Visitors as well as members of the household are found fault with, oftentimes with much bitterness, because they may have disarranged a few ornaments or books, or put a chair out of its place, or did not place the knife, the fork, the napkin, in the exact place that the hypercritical eye of the hostess, whose organ of order is in an inflamed state from over-activity, would wish. It would be well for us to remember, in passing, that the excessive activity of any portion of the brain may produce inflammation and consequent disease. There are women not a few who trouble themselves over-much concerning the orderliness of home affairs, even to inflammation point, and this constant irritation, acting upon the nervous system,

interferes with the whole vital apparatus, and prevents them from properly assimilating their food, which results in their generally being thin, pale and unhealthy; and this comes from the excessive activity of this one small faculty of order. It is very seldom that this faculty of order is found excessive in stout, healthy, cheerful-minded women, for if they had it excessively active, it would soon interfere with their enjoyment, and consequently with their health. One might say much, likewise, upon the other extreme, idiotic deficieney. This extreme is not often to be found, although disorderliness is common, but is not the result of indifference to order, but of physical inactivity, or the mind being otherwise employed; or, in fact, a general all-round laziness, which oftentimes proceeds from want of energy. What an amount of trouble would be saved, and pleasure given, if this organ were systematically cultivated in the young, by teaching them first by the means of their toys (kindergarten system) the beauty of order. Let there be no laborious task about it, or the training of this or any other organ, for the activity of every organ should be an intense pleasure, and what the organ produces should be not a deformity, but a beauty. Our conception of order should be a pleasurable conception of a department in the region of the beautiful.

PLANTS THAT CLIMB.

Darwin has minutely investigated the subject of the movement of plants, especially in climbing plants, and has written several books on the subject. He divided the so-called climbing plants into four classes: (1) Those which turn round a support and are not aided by any other movement; (2) those endowed with irritable organs, which when they touch any object clasp it, such organs consisting of modified leaves, branches or flower peduncles. These two classes sometimes graduate to a certain extent into one another. Plants of the third class ascend merely by the aid of hooks, and those of the fourth by rootlets; but as in neither do the plants exhibit any special movements, they present little interest. The hop's joints while very young may be seen to bend to one side, and to travel slowly round towards all points of the compass, moving like the hands of a watch with the sun. The revolving movement continues as the plant continues to grow. A greater number of twiners revolve in a course opposite to that of the sun or to the hands than in the reversed course, and consequently the majority, as is well-known ascend their supports from left to right. Occasionally, though rarely, plants of the same order twine in opposite directions. Plants become climbers, avers Darwin, in order, as may be presumed, to reach the light and expose a large surface of their leaves to its action and to that of the free air. Without entering into all of the scientific reasons it may be stated that Darwin concluded that this power of circumnutation, as he calls it, is innate and not excited by any internal agencies beyond those necessary for the growth and vigour of the plant. The means by which the various movements are affected he attributed to unequal growth, gravity, and the attraction of the sun, believing, however, on the whole, that the increased growth, first on one side and then on another, is a secondary effect, and that the increased turgescence (swelling) of the cells, together with the extensibility of the walls, is the primary cause of the movement of circumnutation.

IDEAS & INVENTIONS.

Any of our readers possessing ideas, or inventions which they may consider worth patenting, may communicate, free of charge, with our Patent Editor, whose experience in this department, warrants us in believing that the advice given will be sound and practical.

THOUGHT.

We do not fully understand, or at least are not agreed as to the nature or character of normal mentality. Two or three generations ago, it was believed to consist in the activity of a soul or spirit, which was enthroned somewhere in the brain. No explanation of the *modus operandi* of such activity eventuating in thought, as independent of the body, was apparently ever deemed necessary, or considered as a legitimate scientific inquiry.

In more recent times, and especially since the microscope has revealed to us the wonderfully complex and highly organised texture of the brain; and modern physiological research has made known more perfectly the functions of many parts and organs of it, the old theory has been rejected, and a leap has been made to the other extreme. A theory has been accepted by some to the effect that the whole thought process consists simply in the molecular activity of this highly organised cell-structure of brain. The hypothesis that a soul or any special entity exists within the brain or elsewhere in the body, is a snare and a delusion, and without proof. As a working theory, for elucidating the phenomena of mind, it is worse than useless. Perceptions, memory, reason, judgment, all consist of mere movements or vibrations of different kinds or degrees of multitudinous nerve fibrils and cells, which are composed of matter in its most highly organised form. Attention and will are only different forms of this same activity of nerve tissue as it becomes affected through external or internal impressions while under the influence of the blood. In the words of one of the most vigorous advocates, "that which thinks, reasons, wills; that which is consciousness in phenomenon—is the brain; not any suppositious entity, of the existence of which we have no evidence whatever, and of the need of which as an hypothesis he is not conscious."

On the other hand, however, there are some who still feel conscious of the need of an additional element in any hypothesis which is assumed as a working basis for elucidating the physiology of the thought process. They are unable to accept mere assertion for argument, and much less for demonstration. They freely admit the dependence of mind upon the brain and nervous system in its exhibitions, and that no such processes as memory, reason, attention, and will, can be perfected and projected to other minds except by the agency of the brain; also that these several activities of the mind are defective and imperfect, weak or strong, largely in proportion as the brain is in a normal or abnormal condition. They also admit that the hypothesis of molecular activity only has the merit of simplicity, and if true, ought soon to place us on vantage ground in elucidating the physiology of mind. But, on the other hand, they cannot remain indifferent to the fact that any hypothesis, to be accepted as reasonable, must harmonise with and cover the phenomena to be explained. Now, does molecular activity, or the vibration of cells and fibrils upon each other, present any resemblance to thought? Such vibrations presupposes and consists simply in movement. This movement may occur with the inconceivable rapidity of light, but, after all, it is only movement, and if there results from, or in connection with that movement of the anatomical elements of brain, something of a nature unlike motion, then it becomes necessary to add another element, which resides in the material affected by movement, to explain the phenomena presented. This element must be akin, in its nature, to that which results, namely, thought. The nature of movement is simple and homogeneous in whatever realm of matter it may appear, and, so far as we know, it

becomes only motion : but thought, as it appears in reason, will, imagination, and judgment, has no resemblance to mere motion. It may be attended by or be dependent upon it. but in its essence and qualities it is so unlike it that the two cannot be compared. Mere movement of cell, whether simple or complex in its constitution, therefore becomes as unscientific as an explanation of thought as mere movement of spirit.

Such considerations are thought to require that, in the solution of the thought problem, another element must be added. This resides in the brain and nervous system, and in the processes of thought, reflection, memory, and judgment, there exists a correspondence or parallelism of action between the cell and this additional element. The one may act upon or be acted upon by the other through impressions from without, and in this action and interaction, the quality and character of thought becomes modified, approved or disapproved, and in some measure changed.

Such, then, in briefest words, are the hypotheses which have been advanced as explanatory of normal mentality. How far either of them may or may not be likely to meet with future demonstration, it is not our purpose to argue, but simply to call attention to the fact that neither of these hypotheses has yet been accepted by all : and also that physiology has not yet vouchsafed to us any scientific demonstration on this matter.

Prizes for Everybody on Page 94.

HOW MOUNTAINS ARE MADE.

Foremost in their geographic importance, and in the intricacy and significance of their geologic structure and origin, are the mountain belts which consist of folded rock formations. The strata forming the upper part of the earth's crust are bent up and down in long, nearly straight or curving, wave-like ridges or troughs, and where their disturbance was greatest the successive ridged folds are closely pressed together. The waves of the rock structure are then pushed to such steepness that their sides become parallel with each other and the entire fold is driven forward into an inclined position. The order of the strata on the lower side of the appressed fold is thus inverted ; the originally highest and last formed deposits there lie beneath older beds, in an overturned series. Sub-aerial erosion then wears down the undulations and the crests of the closely folded strata, often planing them off until a long section, crossing mountain ranges, passes from older to newer beds, and onward from newer to older, in several alternations, having throughout the whole a nearly constant deep dip. Owing to the interbedding of hard and enduring sand-stone, quartzite gneiss and other rock formations, with more easily eroded limestone, shales, incoherent sandstones, or schists, the erosion commonly produces a new topography, making hollows and long valleys, where the more erosible beds have been removed, and leaving ridges and mountain ranges of the harder rocks. More than this, when erosion has been continued through long periods, it tends towards the ultimate result of removing the upward curved or anti-clinal portions of the great folds and sparing the originally lower downward curved or synclinical portions, until the valleys take the places which were originally occupied by the highest upheavals, while the original troughs, where the rocks were most compacted by pressure, remain now as the principal mountain ridges. Under denudation, the folded mountainous belt fulfills the propheey, "Every valley shall be exalted, and every mountain and hill shall be low."

HOW ODOURS AFFECT US.

The direct action of odours on the nervous centres is a subject worthy of careful research and study. Goethe had a strong dislike to the odour of apples ; Schiller liked the odour. Some persons are made absolutely ill by the odour of onions that are being cooked, while other persons rather like it. The odour of the lily has a most potent effect in many instances, and we believe there is no person on whom it does not produce a sense of depression and nausea. We have known it cause positive faintness. Many are disagreeably affected by the odour of carbolic acid, and can never remain many minutes in a room where a trace of it prevails. In cases where the effect of an ordour is instantaneous, it is fair to suppose that the impression made on the olfactory surface is transmitted direct to the olfactory centre of the brain ; but there must also, in certain examples, be a further transmission to the sympathetic ganglia nerve centres.

The central seat of the olfactory sense must be very near to the central seat of memory, for it is noticeable that nothing recalls a past event like an odour. A little child was accidentally thrown out of a pony carriage in a country lane. Near the spot where the fall took place there was a manure heap, which gave forth the peculiar dry ammoniacal odour so often recognisable from such heaps—an odour distinctive, yet not altogether unpleasant. The child was stunned by the fall, and on recovering and returning to consciousness smelt this odour powerfully. Over fifty years have elapsed since that little mishap, and yet whenever the person referred to passes, in country lanes, a heap giving out the same odour, the whole scene of the accident recurs with every detail perfect, and sometimes with a recurrence of the giddiness and nausea which were experienced at the moment.

In some of the lower animals memory by odours is often singularly exhibited. In the dog the memory by odour seems a special part of the nature of the animal. The "scent" of the fox-hound and of the stag-hound is of this character. In the trained collie the remembrance of an object hidden, a stick, for instance, may be retained for three-quarters of an hour, so perfectly, that the animal will fetch the object at command. But if the object be coated with something giving an odour which the animal is familiar with, the memory is infinitely more prolonged.

Some odours lead to sleep, like the odour from dried hops; others lead to wakefulness, like the odour of dead flowers or leaves. Still others allow sleep but provoke the most terrible dreams, like the odours arising from a pillow in which feathers are decomposing.

Habit modifies the effects of odour. Merciless smokers laugh at the "faddery" of women who become faint if a smoker charges the air they breathe in a confined space, a small room, or a railway carriage, and are ready to compare the objection of a lady unaccustomed to the odour from the pipe or cigar with the carelessness on the matter shown by another lady who has become accustomed to the effect. But if a smoker give up smoking and all contact with smoke for a few years, he is astounded at the unpleasantness of an air charged with smoke when he is then inclosed in it. Dr. Richardson tells us he was once summoned, professionally, to a youth who was temporarily poisoned by inhaling the atmosphere issuing out of a small window of a clubroom in which a number of men were smoking freely. They, in the body of the smoke, were not perceptibly affected. He, partly in the open air, was positively smitten to faintness by the empoisoned current from the room which flowed out of the window, and is still affected whenever he comes within the cloud of a pipe.

THE BOWELS OF THE EARTH.

We have already referred in these columns to the scientific scheme which has originated in America for boring a hole in the earth several miles in depth. It has been long recognised that an inconceivable amount of value in the shape of precious metals and other mineral substances is locked up out of reach beneath the crust of this planet. All the riches dug out of it represent merely the most superficial and ineffective scratchings of the surface. Once render accessible the internal recesses of the sphere, and it is plain that every human being might be a thousand times a Monte Christo.

Geologists are agreed that the interior of the earth is largely composed of metals. Whereas the surface matter of the planet weighs only about two and one-half times as much as water, it is known as a fact that towards the centre, the average weight of things is eleven times that of water. This is due to the circumstance that while this sublunary orb was cooling and condensing, the heavier particles sought the middle. Therefore it is probable that the great mass of the sphere is iron. But there are other metals heavier than iron, and these would naturally form an accumulation immediately about the centre of the globe. Among them may be mentioned most importantly gold. Geologists believe that we might rather expect to find a vast accumulation of gold at that point than anywhere else, the notion being that such of the yellow metal as is found on the surface of the earth is only an accidental detritus, or wearing off of particles from a larger body. However, there are two or three substances known, even more weighty than gold, and one of them is platinum, which has doubled in market value within the last year or two, owing to the increased cost of production.

So it is not unreasonable that certain persons of keen judgment should consider the advisability of boring a hole in the earth for the purpose of extracting some of its metallic contents. For scientific purposes a pit has recently been sunk at Speling, in Germany to the depth of a mile. Unfortunately, water has been struck, and no results which add very materially to human knowledge have thus far been obtained. Another well has been driven at Wheeling, West Virginia, as far down as three-quarters of a mile. It is dry, and the boring process is proceeding at the rate of about ten feet a day. The management will be disgusted if oil or something is not struck before the hole comes out at the antipodes and somebody tumbles into it at the other end.

No really scientific person has been so foolish as to imagine that possible results, commercially speaking, could be secured without digging much further than this. Estimate is made that at twenty miles from the surface of the earth every known substance—metals, rocks. and all—becomes fused and liquid. Once let this point be reached, and naturally whatever is below must spout up of its own accord, without expense of mining. Immediately the price of metals in the market would be reduced to little or nothing, and a new age would dawn upon civilisation. It has been suggested that such an artificial conduit would be, to all intents and purposes, a volcano, but any dangers which it would otherwise threaten might be obviated easily by establishing the works on an open prairie. We have, however, already pointed out in a previous issue the impediments that stand in the way of mining to any considerable depth. These impediments are, no doubt, a wise dispensation.

THE DANGER OF TINNED FOOD.

The following investigation of the condition of foods packed in tin cans was prompted by an alleged case of poisoning, which occurred recently. A man and woman were sick through eating tinned fruit. The attending physician pronounced the case one of lead poisoning. The wholesale dealer from whose stock the tinned fruit originally came procured a portion of the same at the house where the poisoning occurred, and sent it for examination.

The results of the examination showed that the tinned fruit contained an amount of stannous salts equivalent to 6·4 maximum doses and 51·4 minimum doses of stannous chloride per pound. On being notified of this fact the dealer sent a can of the same brand from his stock. The inner coating of the can was found to be badly eroded, and upon examination, one pound of the contents contained tin salts equivalent to 7 maximum and 56 minimum doses of tannous chloride.

The unexpected large amount of tin salts and the claimed ill effects of the consumption of the same, suggested the advisability of extending the investigation to other tinned goods in common use. Accordingly a line of articles was purchased in open market as sold to consumers, no pains being taken to procure old samples. The collection embraced fruits, vegetables, fish and condensed milk. With the exception of the condensed milk, every article examined was contaminated with salts of tin. In most cases the amount of tin salts present was so large that there can be no doubt of danger to health from the consumption of the food, especially if several kinds are consumed at the same meal.

FORGETTING TO DINE.

Shelley could not understand why people wanted more than plain bread. He was so careless about his meals that he did himself serious injury. When during his London walks he felt hungry he would buy a loaf at the nearest baker's, tuck it under his arm and eat it as he went along, probably reading a book and dodging the passers-by at the same time. Mrs. Shelley often sent food to his study, which in his abstraction he forgot, and then, coming out from the room, he would innocently ask: "Mary, have I dined?" This reminds one of the preoccupation of Sir Isaac Newton, who is said not always to have remembered whether he had dined or not, and of the practical joke once played by a friend, who ate the philosopher's dinner, a chicken, which was waiting for him, and then, leaving the bones on his plate, he was amused at the unconsciousness of Newton when he came into the room that he had not dined.

The use of substances which swell greatly on exposure to water has been often recommended as a protective armour for war vessels. The Danish ship *Hecla* is provided with a belt of cellulose three feet thick, and has recently been the subject of some interesting experiments. A five-inch shot was fired at this belt and passed completely through the vessel, leaving two sharply-cut holes in the cellulose. The holes closed up to such an extent that the water passing through was not sufficient to interfere with the working of the vessel, which steamed about without difficulty for three hours.

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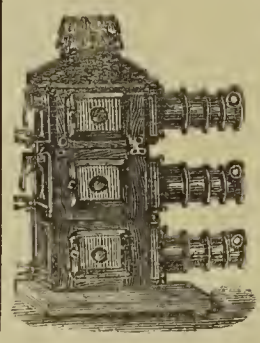

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SCIENCE NEWS AND NOTES.

"There *must* be work done by the arms, or none of us could live. There *must* be work done by the brains, or the life we get would not be worth having."—RUSKIN.

Disease! Disease!!

all is disease, and how much intelligence do we bring to bear in securing immunity from its evil effects? We make a large outcry if the public sanitary officials are remiss in their duty, but do we take any measures to sanitate our own dwellings, beyond sending for a plumber when a smell is unusually prominent, and the evil is already effected? There are a dozen preventives against disease that we ought to observe, but which we don't observe. They only require a little common sense.

Library Books,

we have no hesitation in saying, are a most prolific source of infection. Patrons of circulating libraries are criminally careless in this respect. There is sickness in the house; and books are sent to and from the library, even finding their way into the sick room, where all kinds of disease germs are floating about. This is the way contagious disease, in many instances, finds its way from house to house, and why the origin of the disease appears so mysterious to many sufferers, who have probably done everything else in their power to obtain immunity from disease germs.

Dusting

is another matter over which the orderly housewife shows a culpable want of logic. Be the duster ever so clean and the duster used ever so vigorously, the matter is all the worse, for the dust so energetically stirred up is merely lifted into the atmosphere and lungs—very little adheres to the duster—and the disease germs along with it. The same, of course, applies to sweeping and other domestic cleanings. The remedy is so simple—just try damp dusters, and sprinkle the floors and carpets—even for the most trifling operation—with water, to which a little odourless disinfecting fluid has been added, and there you have a very simple plan of campaign for defeating aggressive germs.

Eight Hours Sleep

is the popular allowance for strength-restoring rest, and perhaps it is a fair average, although there must be many exceptions. Dr. Cold, a German physician, is of opinion that everyone up to the age of 20 or 21 should have 9 hours' sleep out of the 24, and as a rule the allowance is taken. In middle life people who can perform ordinary routine work when they are half awake may suffer no harm with 6 or 7 hours' sleep, but all who use their brains should have 8. This is a matter in which there should be reasonable personal discrimination.

Baldness

according to nearly every authority, is on the increase, and unless the theory of super-activity of the brain be correct, we know nothing of the cause; of the cure still less. Dr. E. D. Mapother, however, recently advanced a theory about the influence of diet on the growth of the hair. Several cases of shedding of hair after influenza confirmed him in this opinion. Hair contains five per cent. of sulphur, and its ash twenty per cent. of silicon and ten per cent. of iron and manganese. Solutions of beef, or rather of part of it, starchy mixtures, and even milk, which constitute the diet of patients with influenza and other fevers, cannot supply these elements, and atrophy at the root and falling of hair result. The colour and strength of hair in young mammals is not attained so long as milk is their sole food. As to drugs, iron has prompt influence. The foods which most abundantly contain the above-named elements are the various albuminoids and the oat, the ash of that grain yielding twenty-two per cent. of silicon. With care these foods are admissible in the course of febrile diseases, when albumen is the constituent suffering most by the increased metabolism. Dr. Mapother often found a dietary largely composed of oatmeal and brown bread greatly promote the growth of hair, especially when the baldness was preceded by constipation and sluggish capillary circulation. Those races of men, he claims, who consume most meat are the most hirsute. Again, it is well known in the zoological

garden that carnivorous mammals, birds, and serpents keep their hair, feathers, or cuticle in bad condition unless fed with whole animals, and the egesta contain the cuticular appendages of their prey in a digested or partly digested state.

Thought Transference

has never been taken up in a practical sense by scientists, although it is exceedingly popular for the purpose of drawing-room experiments. The remarks of Dr. Oliver Lodge on the subject are, however, of particular interest:—"May there not also be," he asks, "an immaterial (perhaps an ethereal) medium of communication? Is it possible that an idea can be transferred from one person to another by a process such as we have not yet grown accustomed to, and know practically nothing about? In this case I have evidence. I assert that I have seen it done, and am perfectly convinced of the fact."

Nice News for Tea Drinkers

is contained in the statement that in China, when a man of high degree dies, his body is embalmed by packing it in tea, after which the tea is again boxed and a private mark placed upon the box, and by this mark Chinamen understand that the tea has been used for embalming the dead, and that it is only fit for *export*. This piece of news is given by a Chinaman. We shall be glad to hear testimony that will once more give us confidence in the delicious Monings and Kaisows that come to us from Chinese ports.

Do Monkeys Talk?

The question is still exercising the minds of people. Even the American professor goes no further than to show that the monkeys can utter sounds which express their feelings or thoughts. The question, however, is more definitely dealt with in some news that comes from the East Indian Archipelago and the Malay Peninsular. Miss Bird, a lady voyager, says that early in the morning the apes begin to call each other with a plaintive "hou houey," which may easily be imagined to bear a similarity to the Australian "Cou-ee," and to have a like meaning, namely, "here I am." Another monkey says "ouf-onf," which seems to be a term of endearment, expressive of a desire for friendly relations, and is freely used to those who make a pet of the creature. "Kwa-kwa" is also a common cry, but nothing has been found out concerning its meaning. No doubt other words might be picked up even without the aid of a phonograph by an attentive observer. These who wish to acquire proficiency in monkey lingo should certainly direct their steps eastwards.

Another Erroneous Idea

is that the monkey cannot be induced to work. Where the cocoanut palm abounds the Malays train the baboons to climb the palms and throw down the ripe nuts. These half-educated monkeys, however, resemble the Malays themselves in having an objection to work for wages, although they are not lazy when roused by more personal motives. The good and bad qualities of the apes are wonderfully human. They are fond of champagne and bitter beer, and get drunk when they have the chance. They are far from being strict vegetarians, and are particularly fond of sausages and small birds. A sick monkey is considered to be getting better when it takes to eating grasshoppers. These eastern monkeys have distinct omnivorous predilections.

These Putative Cousins

of the human race have already exhibited a mental and even mechanical capacity sufficient to give ground for great hopes of possible development in point of intellect. Chimpanzees have been taught to bring things to the table, and the big Langur baboon of India is commonly used in that country to-day as a servant for working the punkah fans, with which flies are kept away from dinner tables. Mr. Stanley's account of apes which carry torches at night, to which we refer in another column, is believed to be an absurdity, because all the anthropoid and simian tribes are too afraid of fire to render such a thing possible. It is a fact well known that gorillas, while they will gather about a deserted camp fire for the sake of warmth, will never think of keeping the embers alight by adding fuel. Nevertheless, every book on natural history relates many an instance illustrative of these creatures' thinking powers, and there is no question that it could be greatly improved by the process of judicious breeding. Even a pig can be taught to count up to ten.

The Female Face,

according to an American professor who has been to the trouble of measuring 2,500 of them, is subject to three distinct periods of growth—the first ending about the seventh year, and the third beginning at or near about the age of fifteen. The abrupt transition from one period to the next is indicated by the very slow growth of children until the age of eight or fourteen, when a rapid development often occurs. From the fifth to the tenth year the average increase is said to be about 6·5 millimetres. During the next four years it is 6·2 millimetres, and from this time little advance is made, the maximum of 128 millimetres—about 5·04 inches—being reached at near the age of twenty. The male face is larger than the female at all ages. Its growth is also more rapid, and continues later in life.

The Interesting Theory

advanced in our columns by a correspondent, respecting the particles of dust floating in a sunbeam, has brought us another interesting idea from Mr. C. Macdonald, who asks:—"Is not the reason due to cohesive attraction? When two particles are moving towards each other is there not sufficient attraction from the surrounding particles to prevent them from meeting? The surrounding particles are pulling them in every other direction. Each particle has to contend against every other particle."

Broken Hearts.

In a lecture delivered some thirty years ago, says a correspondent, the late Dr. J. V. Pettigrew stated that the only case on record of a death by a broken heart was that of a brewer's drayman. We confess we had not heard of this case.

Spirits in Bicycles,

in an alcoholic sense, of course, is the latest outcome of the pneumatic tyre. A cyclist recently formed the ingenious idea of up-to-date smuggling by riding a velocipede with an unusually large tyre across the Spanish frontier. He enjoyed immunity from discovery for about three months, when one day his tyre burst and the secret as well as the liquid leaked out. The cycling smuggler is now unable to exercise in a greater area than the prison yard, and his recreation is confined to pedestrianism.

Modern Science
has given us no more interesting problem than that which refers to the antagonism existing between germs of different kinds, and also between those living enemies of ours and the natural fluid of the blood. This subject, Dr. Andrew Wilson considers, is all the more important because it seems to point the way in which research into the prevention of many serious maladies must be conducted. To begin with, the natural powers which the blood appears to possess in the way of defeating disease germs, it may be borne in mind that our vital fluid really consists of a liquid, called the serum, colourless in itself, and containing the little bodies called corpuscles. Of the blood corpuscles, two kinds are known—red and white. The former carry the gases of the blood, and are the means whereby the vivifying oxygen is conveyed to all our tissues; while the latter are living cells, composed of protoplasm, and exhibiting a vitality which is semi-independent of us. The serum, or blood-fluid, is now known to be a more complex liquid than was originally supposed. One thing is certain, that the serum of the blood of a rabbit vaccinated with rabies from a dog is found to destroy the infective power of the rabies-poison, and the serum will retain this power of protection against the dog-poison for several days if it be kept at a low temperature. A whole list of experimental results with regard to the protective power of serum—which, it may be added, varies considerably in different cases—has been tabulated, and much may be hoped from the further pursuit of investigations in this direction.

The White Blood-Corpuscles,
or "phagocytes," as they are scientifically named, yield, on investigation, matter of equal interest. Dr. Andrew Wilson tells us how these wonderful living particles, which exist by millions in our blood, have a knack of passing out of the blood-vessels and of wandering at their own sweet will through our tissues. They have been seen to attack and to eat up the disease germs with which animals have been inoculated, and in the water-fleas they are discerned combating the vegetable spores which threaten to kill these minute crustaceans. Then we are shown that the roots of our first teeth are eaten away, preparatory to the easy riddance of these teeth, by the white cells; and the tadpole's tail, which disappears when the frog stage is reached, is similarly disposed of by the attack of the phagocytes. So that within the bodies of animals at large, there live and exist these white blood-cells, which discharge the work of a roving sanitary police corps; and one view of immunity or escape from disease is that when we do succeed in evading ailments of germ-origin our white cells have conquered the germs. Conversely, when the disease masters us, this contingency is held to be the result of the defeat of our microscopic friends. True it is that scientists are not quite agreed as to the respective virtues and powers of the blood serum itself, and of the white blood-cells in this matter of disease-prevention. At the same time, it is not impossible that both means operate to secure our safety from the omnipresent germ when we are threatened with attack.

Apropos of Germs,
it is somewhat amusing to notice the present-day fashion of setting one microbe to battle with another, especially in the case of that too-common malady, typhoid fever. It appears that M. de Bavay made a series of observations regarding the action which yeast possessed on the bacilli to which typhoid fever owes its origin. Yeast, as we explained in a previous issue of SCIENCE SIFTINGS, consists of microscopic plants, each a living cell, the one-thousandth of an inch or thereabouts in diameter. Fermentation is the result of the growth and multiplication of these yeast-plants, as Cagniard de la Tour discovered about 1843. The little leaven that leavens the whole lump is a Scriptural statement of a modern scientific fact. You sow a few yeast-plants in an appropriate sugary soil, and the few multiply and become thousands, and fermentation, so far from being a purely chemical proceeding, is thus seen to be a truly vital action. Now, yeast-plants have a power of fighting with and of conquering typhoid germs; so the very last thing in medicine in this direction is the administration to patients of food saturated with yeast. The result is that the typhoid bacilli are starved out. They cannot flourish and grow in such surroundings. The yeast is believed to form an acid which is fatal to the growth of the bacilli. This is an idea or method in treatment which seems likely to bear good and great results. Already, in other directions, physicians speak of disinfecting the digestive system, which is the seat of typhoid attack. Dr. Wilson considers the yeast treatment is much simpler and better, if only for the reason that we employ therein a living remedy, naturally fitted, as it appears, to attack and overthrow the dreaded microbe.

Artificial Incubation
was not invented by man. A specimen of the bush turkey of Austria has just been added to the Zoological Gardens. This remarkable bird does not make a nest in the ordinary way, or sit upon eggs until they are hatched, it goes upon quite a different plan. It constructs a great heap of refuse, which any visitor to the Zoo may see for himself, and in this heap, which is usually composed of dead leaves, the eggs are buried. As the heat produced by the decay of the leaves is great enough to hatch the eggs, the bird is able to evade its maternal duties and to throw the responsibility of rearing its offspring upon Nature. We wonder if the inventor of the incubator took his idea from Nature.

The History of Chloroform
is most interesting. The drug was discovered by Samuel Guthrie, of Sackett's Harbour, N.Y., in 1831, and during independent investigations by Liebig in 1832. In the year first mentioned it was employed as an anæsthetic by Dr. Ives, of Yale, and soon came into almost universal use. It is estimated that over 100,000 pounds are annually consumed in the United States alone as an aid in surgical operations. In 1864 the Royal Medical Society of England made an investigation to determine whether the death-rate had been increased by its use, and decided the question in the negative. The employment of some substance to deaden the pain of surgical operations was not unknown before. Greek and Roman surgeons used mandragora, and the Chinese and Indians employed hasheesh.

Fog and its Evil Effects
were dealt with cursorily in our last issue. We now have the report made by the Kew authorities regarding the effect of these blackenings of the atmosphere on the flowers in their gardens and conservatories. After a few days of fog, even in a locality so far up the Thames as Kew, owing to the "tarry hydro-carbon" in the air, the leaves are covered with a stuff like brown paint, which can only be scraped off with a knife. An analysis shows that it contains over fifty-one per cent. of carbon and hydro-carbon, and about forty-one per cent. of metallic iron, magnetic oxide of iron, and mineral water, chiefly silica and ferric oxide (rust). Curiously also, these ingredients are more plentiful in the deposit

from the fogs at Kew than at Chelsea, pointing either to the fact that local causes contribute to the impurities, or that by some vagaries of the wind the dirty London air is concentrated over what was once a rural haunt and is still the home of the finest garden in Britain, although how long it will be possible to grow delicate plants there remains to be seen.

The Writing Telegraph

instrument was exhibited recently at the North American Telegraph Company's rooms in Chicago. The test was between Chicago and St. Paul, more than 400 miles, and, despite unfavourable weather, the result was successful. The instrument is very simple. The only thing visible is a roll of tape, the same as used in tickers. The operator takes a pencil, and placing the point on the sensitive plate in the opening, simply writes his message, and at the receiving point it is duplicated on the tape. In this manner pictures can be traced, maps drawn, and notes signed at the distance of thousands of miles. Experts claim it will do away with the Morse system, and can be worked at a rate of 45 words a minute.

Sleep

is, of course, the grand renewer of vitality, and the limit of a man's power to do without sleep has been the subject of curious experiments. Lord Brougham once tried it on himself, and beginning Monday morning, kept awake till Tuesday night, when he fell asleep on seating himself while trying to dictate to an amanuensis. The recent competition of six men in Detroit, in trying to postpone sleep for seven days, is equally interesting. Beginning on Monday morn, four of the men failed before Thursday. A fifth kept up till Sunday morning, had a hard struggle with his sleepiness all through the day, and succumbed at midnight. The sixth completed the time and was conducted to the stage and introduced to the spectators, but was sound asleep before the introduction was over. It is said, however, that these men were allowed to sleep in fifteen-minute naps at the end of their several vigils, and it is added that they suffered no permanent ill, although, doubtless, if the experiment be repeated, they cannot look for the same immunity.

What shall we do with our Girls?

has been exercising the minds of English mothers—fathers, too, for the matter of that—for no inconsiderable time. The recent census shows an excess of females over males of nearly 900,000. What is to become of this surplus womankind? It has been shown that they are freely entering the lists against men in the struggle for life, and working for a sum on which it is utterly impossible to exist. The daily press has been recording the case of one association that employs many thousands of respectable girls, at salaries ranging from 6s. to 8s. a week. A woman of this class cannot live on this and travel to and from her place of business. But, nevertheless, the money comes out of the pocket of the male worker, and deprives these women folk of the possibility of attaining the very goal for which they are making—matrimony. It is apparent that by impoverishing men, through reducing the price of labour, our sisters are rendering matrimony impossible, hence the number of spinsters is growing enormously. The men likewise suffer by being deprived of the regularity of married life. It is curious to note that although the birth-rate shows an excess of male births over female, yet this surplus female population exists, and is accounted for by the far greater mortality among the male element. In short, the single man is not nursed and cared for with the same attention as his married brother. Women are now following the pursuits of men; men have to care for themselves. Social science will have to solve this problem some day.

The Rain Producers,

as we hinted in a recent paragraph, will soon be turning their attention to the inverse experiment, the production of fine weather. The beginning in the contrary direction has been made in Tarbes, in the Hautes Pyrenees, a district liable to destructive hailstorms with violent lightning, which ruin the vines and other plants. As hail in summer is apparently a result of atmospheric electricity, the Director of the Observatory of the Pic du Midi has erected high poles at Tarbes, having metal caps and connected by wires. His idea is to steal away the electricity of the clouds, and thus prevent the formation of the hail.

In the Glorious Future

we shall no longer dread the extremes of heat and cold, for even in the present day man has commenced to experimentalise for the purpose of annulling the disagreeable and often distressing effects of these variations of temperature. We learn that it is proposed not only to heat Kansas City with warm air conveyed through pipes from a common centre, but to cool it—which for four months in the year is quite as important—by refrigerated currents. The first-mentioned convenience has long been common in the public buildings of Great Britain, but less so in private houses. But in America it is universal. No first-class residence is without a furnace in the area by which the rooms are heated; the old-fashioned stove, which is hard to keep in moderation, being now confined almost entirely to humbler dwellings, or to those which date from what is for the New World a sort of pre-historic era, or, what is the same thing, from a period known as "before the War." If these experiments prove effectual in Kansas, we shall certainly soon hear of similar efforts being made nearer home.

One Hundred and Fifty Miles an Hour

is the estimated speed at which the projected Viennese electric railway will run. The trains are to consist each of a single vehicle only, constructed after the manner of our Pullman cars. Of course it is impossible to set a limit to the powers of the modern wonderforce, and it would be worse than rash to predict that such a development of railway speed would be an impossibility. Only one begins to think, says Dr. Andrew Wilson, of possibilities of accident, of the required revolution in signalling arrangements, and of many other items connected with the wear and tear of the rolling stock which such a rate of travelling necessarily implies. Also, what about the sensations of the passengers? There is ease and comfort in bowling along the Great Northern, London and North-Western, or Midland main lines at a speed of seventy miles an hour, but at double this rate we might have to experience sensations the reverse of pleasant. This last, however, is a moot point, and possibly custom, here and elsewhere, would become a second nature. Life goes fast enough to-day. What would it be with Aberdeen within four hours' journey or so of London?

Many of our readers have doubtless seen the conjuring trick known as the "magic hand," which is placed upon a glass plate and answers by means of sundry raps any questions put to it. This mysterious rapping is accomplished by means of an invisible horizontal thread worked by an assistant behind the scenes of a theatre.

THE PRIZE SCIENCE SIFTING.

One Guinea will be paid each week to the contributor of the most interesting or curious Science paragraph.

The paragraph must not exceed 200 words, and need not be original, but in this case, the source from whence it is copied must be given. All paragraphs must reach us on Monday, and be marked "Prize Science Sifting" on the envelope, unless a postcard be used. Only one paragraph may be sent in by each competitor.

The Editor reserves the right of publishing any paragraphs sent in.

We have awarded the prize of One Guinea to Mr. WILLIAM LIGHTBOURN. 72, Audley Range, Blackburn, for the leading "Science Sifting." The other siftings published all deserve honourable mention.

Unlimited Divisibility.

If a mass of marble be reduced to a fine powder by the process of grinding, and this powder be then purified by washing, its particles, if examined by a powerful microscope, will be found to consist of blocks having rhomboidal forms, and angles as perfect and accurate as the finest specimens of calcareous spars. These rhomboids, minute as they are, may be again broken and pulverised, and the particles into which they are divided will still be rhomboids of the same form and possessing the same character. The particles of such powder being submitted to the most powerful microscopic instruments, and the process of pulverisation being pushed to the utmost practical limit, it is still found that the same forms are reproduced.

The Age of Eggs.

Before eating an egg, you would perhaps like to know how old it it is? Well, you can easily satisfy your—not by any means idle, if you value your health, but a very necessary—curiosity by simply trying its density in the following easy and practical manner: Dissolve four ounces of common salt in about two pints of water, using a glass vessel to hold it, in order that you may have every possible chance of studying the different movements and positions of the egg. Having selected your egg, the next thing to do is to place it gently on the surface of the liquid, then take your hand off, and watch the egg closely. If you have got hold of a new-laid one, it will sink to the bottom like a shot. If it stops short of reaching the bottom quite, and yet still keeps floating near it, only just a little above, you may put it down as fit and reliable, being one day old; but if it suspends itself about the middle, between top and bottom, you may calculate its age as three days old. Possibly, and very often it is the case, that it will not go down at all, but despite your efforts to push and keep it below water with your finger, will remain as lightly as a cork on the surface. It will be wisdom on your part to cast that old friend from you, for its age is beyond calculation. The older the egg, the lighter it floats, and following up that comparison, it is possible that it may not need any water, or any other liquid whatever to float on, but can do so air alone. Another simple plan of knowing if an egg is good or not is this. Hold the egg up to the light between your thumb of the right hand and finger, which encircle it, and with the left shade the eye. By this means you would be enabled to detect any little spot in the egg. If all light and transparent, it is a fresh one, and in an excellent condition. If a white spot here and there is discoverable, it is fairly good, but hardly fit to eat, being more suitable for puddings. If it looks black, throw it away, it is poison.

V. Tudor, 6, *Edbrooke-road, W.*

The Future of the Microphone.

The microphone is an instrument for increasing or multiplying sound. By it you may hear the noise made by the tread of a fly, as clearly and loud as that made by the march of an elephant across a wooden bridge. Perhaps in time we shall hear in the concert halls, violins, as loud as orchestras, and pianos as loud as church bells.

F. Scott, 79, *Leighton-road, Kentish Town, N.W.*

Whist.

We sometimes hear of remarkable hands at whist, and cases are known of one player having all the trumps. To show how rare such an occurence is, it is useful to know a single pack can be dealt into 635,013,559,600 hands or the chances are this number to one against any person having a peculiar hand. Mr. Babbage, the great mathematician and inventor of the calculating machine, found that if 1,000,000 men dealt cards for 100,000,000 years at the rate of 1 deal per minute, they would only then have exhausted $\frac{1}{100000}$ part of the total number of variations possible,—curious facts.

T. Marshall, 13, *Lawn-road, Hampstead, N.W.*

The Power of Coal.

It is not generally known the great power that can be got from coal if used economically. One pound of good Newcastle coal will give out 14,000 units of heat or about 10 million foot pounds of mechanical energy, or enough energy to supply an engine of one horse power for 5 hours. Of course, with the present appliances *all* this cannot be utilised, but as improvements come we will be able to use a great deal more and get nearer this figure. It is also capable of turning 14lbs. of water into steam.

W. D. Ross, 3, *Cyprus Cottages, West Lane, Plumstead.*

Can we Believe our Senses?

Try a little experiment. Cross the first and second fingers of one hand as far as possible, and rub, say a marble, between the tips. You will distinctly feel two marbles. Try again. Substitute the tip of your nose for the marble, and lo! you will feel two noses! Even perform the experiment before a mirror, and while your eyes are telling you that the chief ornament (or otherwise) of your face possesses only one tip, still your crossed fingers will distinguish two, touch and sight thus contradicting each other. This is a simple way of proving how easily the senses can be deceived. Our senses are schooled to attributing certain impressions to particular causes, and if we produce a well known impression in an unusual manner, sense can no longer be depended on. Thus, in the above experiment you cause one point to touch the opposite sides of two adjoining fingers, but this can only be done by two points when the fingers are in their natural position. The judgment of the sense is at once completely upset and the impression received through the touch is that of the contact of two noses with the fingers.

Leone G. Chiozza, 36, *Colvestone-crescent, Dalston, N.E.*

The Music of a Poker.

If a long strip of flannel be tied to the middle of a common poker, and the free ends of the flannel be rolled round the end of the forefinger of each hand, then the ends of the fingers be placed in the ears, and the poker struck sharply against the edge of a steel fender, a deep tone will be heard like that of the largest church-bell. The flannel acts as an excellent conductor of sound.

F. Ellingworth, Northgate Cottage, Oakham.

GLEANINGS OF THE GLOBE.

THE average crop of oranges and lemons in Italy is 3,776,575,500.

THE solution of cubic equations is due to the genius of Nicolo Tartaglia, who was born at Brescia in the year 1500.

AN important application of chrono-photography has just been made in Paris, which it is believed will have important bearings upon the invention of flying machines.

RECENT experiments show that if the tassels are removed from growing corn before pollen is formed a much larger amount of grain will be produced.

A NEW theory in relation to the moon has lately been advanced, to the effect that the lights and shadows of the moon are incompatible with the theory of its spherical shape.

THE effect of the electric light current on the compasses of some vessels is so great that it becomes necessary to determine how many hours the dynamo has been running before working out the vessel's reckoning.

AN artificial mountain, a mechanical and phonographic Adelina Patti, and a Pulman car, consisting of several waggons hewn out of a single redwood tree with its bark at the top left untouched, are some of the wonders of the Chicago Exhibition of 1893.

COMPRESSED air, charged with the vapours of eucalyptus oil and creosote, is the subject of a recent communication to the Paris Academy of Medicine as a cure for consumption. The patient is placed in a room filled with this air for a couple of hours daily.

STAIR climbing in new and important buildings promises to be a thing of the past. An invention consisting of a small step running along the inside of a balustrade and actuated by electricity has been put into actual practice with successful results.

RECENTLY a shower of stones fell at Pel-et-Der in the Department of the Aube, France, during a violent hail-storm. These unwonted drops have been examined by a geologist, who finds them to be of chalk from Chateau-Landon, which is 150 kilometres from Pel-et-Der. It is believed that the stones were lifted into the atmosphere and conveyed by a whirlwind.

BY a comparison of records, extending over a number of years, it has been concluded that the moon has an influence in lowering the height of the barometer in the months from September to January at the time of full moon, and in raising it during the first quarter. No effect has been perceived in the other months.

THE brightness of the moon is not so very much greater than the brightness of the same area of the sky. The total light of the full moon can be compared, it is said, with the total light of the sun although it is a very difficult problem, and the result, we learn, will be that the sun is as bright as 680,000 full moons.

FRENCH scientists are puzzling over a spider which was discovered in a cavity in a stone. It is estimated that the stone must be 4,000 years old; this notwithstanding, however, the spider is quite lively and very youthful in its antics. It is blind, and has no mouth.

HAIL storms do not occur in well-wooded districts, according to the observation of a noted Swiss forester. In evidence of this, he points out that a district formerly exempt from such storms has been visited by very fierce ones since gaps were made in the forests, and that upon replanting the cleared ground with firs the storms ceased entirely.

CHLORIDE of ethyl is being used by the Swiss medical men to produce local anæsthesia by refrigeration. In addition to its use for operations, it is of value for checking sciatica, toothache, and other painful nervous affections. A five-per-cent. solution of carbolic acid in water injected into the gums is strongly recommended by an American physician.

M. CROUZEL, pharmacist, La Réole, reports a curious case of poisoning in the family of one of his customers, caused by eating stewed pears which had been cooked in a cast iron pan. Fortunately, there was no fatality, but four persons who had partaken of the dish were made seriously ill. M. Crouzel found a large proportion of iron and a small quantity of antimony in the juice.

THE greatest known depth of the ocean in the Pacific is near the Ladrone Islands, where soundings were made to the depth of 26,850 feet, or a little over five miles. In the Atlantic the greatest depth found is just north of the West Indian Islands, which is 23,250 feet, or nearly four and a half miles. In those parts of the ocean most free from islands, as in the route Newfoundland to Ireland, the ocean is most shallow, seldom exceeding 12,000 feet.

IT is often desired to test well water for injurious matter, animal or vegetable? A chemical and bacterial analysis is the best way of doing this, but even such analyses are not of absolutely certain interpretation. One simple method, however, for a home test is to drop some sugar into the sample and leave it undisturbed. If it remains clear it is assumed to be of good quality, otherwise not.

THROUGH experiments made by the military authorities it has been found that whenever the atmosphere is laden with smoke or mist, the power of an electric light is greatly diminished by crossing the beam of light by that of another at a certain angle. At the point of intersection the illuminated space is practically made a screen. It is proposed to utilise this knowledge, since the electric beam can thus be made to serve as a screen, at the back of which tactical operations might be conducted in secret.

IT is a common experience among mountain climbers to find butterflies lying frozen on the snow, and so brittle that they break up unless very carefully handled. Such frozen butterflies on being taken to a warmer climate recover themselves and fly away. Some insects which habitually hibernate, as larvæ or pupæ, do not suffer from being frozen even for a lengthened period; but what is known as an "open" winter, with its alternations of wet, warmth, and cold, is far more fatal to them.

THE MAN OF THE FUTURE.

Man being, zoologically, the highest organism known, the question of his further evolution and its probable direction is one which is naturally of interest to the student of anthropology. Is the development of a higher species possible or probable?

In order to even partially answer this question we must first consider what would constitute perfection or an approach to it. We are met at the very threshold of the problem by the fact, apparent on every hand, that the human product of our present civilisation is, in the vast majority of instances, a very unequally developed organism, physically and mentally: an asymmetrical creature, the victim, so to speak, of specialism of one kind or another: it may be of environment or of occupation, usually of both. Hence the necessarily great diversity of view as to what would be improvement in the race.

It is a self-evident fact that improvement of the individual means, in the long run, advancement of the race: but when we ask what constitutes individual improvement, we receive one answer from the sociologist, another from the political economist, a third from the athlete or artist, and still a different reply from the philosopher.

That an easily-governed and equably-tempered people are not necessarily of a high type of humanity is evident from the experience of China, where a population of 350,000,000 is governed by a standing army of only 80,000 and the simplest police regulations,—a state of affairs unparalleled in the history of the so-called civilised nations. The perfection of their civil service and the insignificant expense of state officials are also said to be marvellous in the light of our experience. This state of affairs has been attributed to the perfection of their social training system, but it seems also allowable to suppose that many centuries of low diet, with overcrowding and mental subjection, have largely eliminated that spirit of restlessness and opposition to authority so characteristic of western peoples.

The ideas of the gymnast or exponent of physical culture and of the purely intellectual sophist, are equally at fault in the solution of our question of improvement of the race; for it is evident to all medical men, at least, that powerful muscles may be a source of vital weakness to their possessor by inducing heart strain, or by overtaxing the eliminative capacity of the kidneys and other depurative organs, in the disposal of the results, the ashes so to speak, of muscular combustion. And, again, even a powerful brain may be menaced in its integrity by a weak or diseased blood-vessel incapable of withstanding the pressure caused by high functional activity.

The zoologist, therefore, sees the true strength of the individual, the race, and the species in (1) their plasticity, i.e., adaptability or capacity for modification in response to changes of environment, provided this plasticity be not the cause of localised weaknesses; and (2) equilibrium of development, organic balance, so to speak, between the component parts of the animal.

The question has been asked, would not the development of wings or other additional organs be an improvement in the species? The reply to this, on zoological principles, would be No. The addition of wings, for instance, would be a retrogression to a lower type; and if the wings were feathered, a still further retrogression. We must conclude, then, that wings are incompatible with progress, zoologically considered, all visions of angels to the contrary notwithstanding.

In fact it is difficult to foresee any structural change of plan that would be an improvement under our present environment.

While, therefore, we may anticipate an increase in the average perfection of parts, and consequently a more harmonious development of man's present plan of structure, we cannot rationally look for any radical change in the plan itself. Hence we may conclude, upon purely theoretical grounds, as well as zoological experience, that under present conditions man is, in his plan of structure, the highest type of animal that can be produced: and while this may seem to coincide with the philosophy of the fatalist, "whatever is, is right," it is nevertheless true.

Improvement in organic balance or correlation of organs, therefore, is the chief direction of advance possible, and this improvement may be favoured by the avoidance of excessive specialism in environment and occupation, by which certain organs are over-developed, while others are dwarfed from disuse.

The ideal man is the perfectly balanced man, physically and mentally; neither an athlete, an intellectual giant, nor a zoological monstrosity, but a being harmoniously developed in all parts.

It may be objected that such an organism would, like the "one-hoss shay" go to pieces all at once. But would not this imply a useful capacity and activity up to a good old age, of which we have striking examples, and be vastly preferable to a break at forty from some one weak organ?

The maxim, "A chain is only as strong as its weakest link," applies here as forcibly as it does in mechanics.

SMELL OF PLANTS.

The investigation of the influence of external factors on the smell of plants has shown that the direct and indirect influence of light is of most importance in the formation and evaporation of the etheric oils on which perfume depends. The odour of strongly fragrant flowers is intensified by heat and light, and is lessened in darkness without quite disappearing. When the whole plant is deprived of light the buds which were before pretty well developed yield fragrant flowers, the others are scentless, while if the flowers alone are darkened, all are fragrant. Certain plants open their flowers and smell only by night, but when these are kept continuously in the dark they in course of time lose their scent and also their starch. When light is again admitted to them they regain both starch and fragrance. Respiration has also a decided influence on smell. Nyctcrinia inclosed in a bell jar with oxygen behaved normally, but with hydrogen the flowers did not open and had no fragrance.

OUR FIRST LIGHT.

The Roman candles were strings soaked in wax. Splinters of wood dipped in oil were used in England as late as the year 1300, and not until 1484 was the Wax Chandlers' Company established for the regular manufacture and sale of wax or grease candles. These were dipped candles; molded candles were two centuries later still. It is believed that the Wax Chandlers' Company's candles more nearly approached the modern article than any which had ever been made before. What are called candles in the Scriptures were not such, but were really small lamps shaped like a sauce boat and having a wick made of rags. Many substances have been used in different countries for the manufacture of candles. The Chinese use a species of wax from the candleberry tree, while paraffin, spermaceti and various oils solidified have also taken the place of tallow and wax.

IS ALL FLESH IMMORTAL?

The question of the possible immortality of animals has of late received a good deal of attention, and from very diverse sources. Since the evolution theory has been fully unfolded, and generally accepted, a good deal more emphasis has been placed on the unity of the animal kingdom, man, of course, included. It has been insisted upon that if we trace life backward far enough into geological eras, there is no escaping the fact that it all has one origin. Now where, it is urged, are you going to draw the line, and say this is immortal and that is not immortal? Of course the rebuff is a very strong one of those who answer, how can you prove that anything is immortal. If it comes to a question of the immortality of mosquitoes as well as man, why let the whole thing go! It becomes an absurdity. Then others come in with the theory that, while no one is immortal, all life is immortal, and that our hope is not so much to be personally persistent beings hereafter, as to be a part of the life flow that develops onward. That was what Orientalism reached. Buddha said that our hope was to be reabsorbed into the All Life, and to live over again according to the quality of our present, live and its virtues or vices. This puts animals and man on the same footing; and, in fact, it was distinctly said by Buddha that a man might reappear as an animal, or an animal as a man. But the pure logic of the case seems to be, either individuality is preserved or it is wholly lost. If lost, it cannot reappear as an animal or a man, but is wholly broken up in the sea of individual life, and will flow out in all directions.

We have, however, just now to take the popular opinion as granted that human beings are immortal, or at least may become immortal, and to ask if animals are to be debarred from all future existence. We have seen what a Buddhist has to say on the subject. He believes that animals are on the same footing with us. Some of the old Greek philosophers, notably the Pythagoreans, were of the same belief, and for that reason forbade the use of animal food. Early Christianity was absorbed in another field of speculation. When science began to speak of our descent from animals, or rather ascent, it shocked Christendom as no other doctrine ever did. But gradually it began to be felt that Darwinism, while exalting animal life, did not dishonour or degrade human life. We are compelled, therefore, to discuss the question once more that Empedocles settled, as he supposed. It is easy to say, as it has been said, that although men spring from animal parentage, they do not get all their faculties from that source; that the moral and intellectual powers cannot be accounted for on the basis of natural evolution; that a spiritual power took the anthropoid at a certain point, and put into him a new something, better and grander than what he got by nature. The pinch of any such logic is that we must allow, if it be true, that the animal evolution progressed alone and unaided to a point capable of being inspirited.

We have got quite beyond the position when science is willing to make any such distinction. On the contrary, science is daily pushing back to show that intellect and ethics belong to the lower forms of life. A careful observer of nature is astounded at the wisdom of insects and very low organisms. In South America, tadpoles are carried overland on the back of the parent, attached by the mouth, to a new pond, when the home pond dries up. The wisdom of birds in trying to lead dangerous characters away from their nests is also most remarkable. What marvellous mechanical skill is shown by spiders! A racoon is reported as having shown remarkable logical acumen. He was fastened by a chain in the stable. He tried to catch the chickens, but failed. But one day he spread a part of his dinner inside the stretch of his chain, in a circle. He then pretended to go to sleep, but still spying carefully. The chickens, seeing him asleep and the food at hand, went within his fatal trap, and were pounced on and caught. On another occasion, a cebus, a monkey of low grade, proved a continuous study for his displays of intelligence. His curiosity covered all things. His powers of observation were accurate. It used sticks and stones much as man does—reaching for things out of his reach and striking with human precision. Hitting the bald head of a friend with a peculiar source of pleasure. These notes are very voluminous now-a-days, and we believe no one of average good sense any longer feels annoyed at being classified in the animal kingdom.

Nothing has struck us as more remarkable than the reports of M. Fatio before the Physical Society of Geneva, in Switzerland. The snipe, he tells us, he has repeatedly detected exercising medical and surgical powers. It makes a dressing for wounds, and even applies ligatures to broken limbs. He on one occasion killed a snipe, which had on its chest a large dressing of down, pulled from its own body and placed in the flowing blood. This coagulating, soon created a perfect dressing. He goes so far as to tell us of a snipe whose limbs he had accidentally broken, and the next day catching it, found its legs so bound up as to be essentially splinted. Another observer tells of a snipe that was found to have bound its broken leg with moss and feathers. Around the leg was wound grass, and this was fastened with a glue.

We hesitate somewhat in quoting the following from Mr. Stanley's book on Africa. The forest of Msongwa, Stanley tells us, is infested by a tribe of chimpanzees of great stature, who make almost nightly raids on the villages and little plantations of the Mswa peoples, carrying off their bananas and other fruits. There is nothing so remarkable about this fact, since many kinds of animals make pillaging forays upon human habitations; but the story that Stanley repeats as coming from Emin Bey, adds that these chimpanzees certainly have the art of making a fire, and that in their raids they make use of lighted torches to hunt out the fruit by night.

Prince Krapotkin, in his studies of animals, has laid special emphasis on their mutual aid and social acquirements. Speaking of squirrels, he says: "Apart from the few hours given each day to foraging, they spend their lives in playing in numerous parties." The ground squirrel is given to hoarding, and stores up in its subterranean halls large amounts of edible roots and nuts. It seems even to be a miser, with a miser's pleasures. Yet it remains always sociable. It always lives in large villages; and Audubon found several individuals in a single apartment. "The villages of the prairie dogs are one of the loveliest sights. They go visiting with one another; and the beaten footpaths which connect all their heaps, testify to the frequency of the visitations." After some tender memorials of the deer and reindeer, Krapotkin adds: I ought to say a few words about the compound families of the elephants, their deliberate ways of posting sentries, and the feelings of sympathy developed by such a life of close mutual support." Of course, social life among animals is nowhere so complex as among apes—with the exception of a few tribes. "They live in great bands. The cries of distress of one of the band immediately bring together the whole to repulse the foe. Even eagles do not dare to attack them."

A good deal has been written of late on language as the permanent barrier between animals and human beings; but

it must not be forgotten that the whole realm of animals converses. There are as many animal languages as there are human. The real separation is at the point of articulation; and that is not possessed by animals, because they lack organs for articulating. The dog, the monkey, the horse, some of the birds, nearly or quite have the organic ability. But, having it or not, they all talk. Max Muller, poet first and physiologist second, has brought about a ludicrous confusion by arguing that as animals have no language, they cannot think. But they have language. It is a wretched conceit to suppose that our method of compounding sounds is all the language that is possible. "Pa" and "ma" are the foundation of human speech, the corner-stone of our dictionaries. But every calf and lamb begins, as every human babe begins, with ba and ma, only he gets no farther, and the babe does.

Interesting as all this is we have quite enough of it. Does it demonstrate animal immortality, or does it destroy the plausibility of the argument for human personal perpetuity? We must have this subject clearly worked out. We fail to see why any animal more than another must be immortal, simply because possessed of mental power. Certainly one argument could hinge on such facts. Some one might say that if such creatures are not immortal, then there is vast creative waste. To this we reply not so, for each successive stage in evolution has become the stepping stone of a higher. No demonstration of natural immortality as based on the mere fact of conscious existence can stand for a moment. Science has declined to interest itself at this point, but it does approach the subject in another direction, and while it cannot fully draw the line between conscious and self-conscious creatures, it shows that there is a wide distinction between these two states of being. It shows that organic life did develop not only structurally upward from the cell to a complex organism, but from a merely sentient creature to censentient or conscious creatures, and finally, in man, to a self-conscious being.

FAME OR FORTUNE.

Can one do his best and most in this age if it does not pay? Is it a sign that he is mercenary if he cannot? We live by the pen. We have learned that thoughts have a market price. They are as salcable as corn or cotton. They are always in demand. Why shall we expect a man to live for fame only—especially posthumous fame? Honestly, now, would you rather be a living millionaire or a dead Shakespeare? Well, it is not your calling to answer such a question, for the chances are now-a-days that cash and reputation go together. If Shakespeare were now alive, he would probably be a millionaire. There is a good deal of humbug about fame. Most people stand boldly as champions of the "almighty dollar," simply because it is almighty. It locks and it unlocks. The best story now current is that of the minister who every Saturday night borrowed a few sovereigns to have in his pocket while preaching on Sunday. It gave him confidence, and a conviction of importance. He felt himself a man of affairs. He could discuss another world better with some command of this world.

There is not a blush for any man's cheek who works for money. It is not a bit meaner that he should. There is no reason in the world for setting some of us aside, and saying to us, "There, you folks must work for the good of it—the reputation of it." There is no more reason why we should gnaw our finger-nails than the merchant.

PHRENOLOGY EXPLAINED.

By Stackpool E. O'Dell,
Author of "Phrenology: its Truthfulness and Usefulness," "Old St. Margaret's," "Merciful or Merciless?" "Brompton Lectures," "Mental Troubles," etc.
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VII.

There is a faculty of the human mind that we call calculation, the organ of which is placed on the external angle of the eyebrow. If it be large, there is a projection and fulness. Let us remember as we go along the two sides of phrenology—its psychological and physiological sides. Its psychological side is of the most consequence, most free from debate, and easier to be understood. The psychological side of calculation is thus understood: the power to calculate is a mental condition that we all have in various degrees. This is a fact quite apart from any physiological arrangement of localisation; so with all the faculties. Calculation embraces all things connected with number and plurality. In respect to this faculty the degrees of power are very numerous, from the child who is semi-idiotic in this respect and is foolishly constantly punished because he cannot calculate the smallest sum in addition, to the astronomer who deals in calculations of millions and even billions with the greatest delight and most pleasurable emotions. If we tell an individual who has the organ of this faculty small, of the possibility of any man deriving pleasure from the calculation of figures, it appears almost incredible to him; yet this is the case, and the reason for the difference lies in the size and activity of that portion of the brain specially devoted to the object of calculation. Upon the ability and accuracy of this faculty very much depends,—nearly all sciences are based upon it. Were it not for this factor of the human mind, civilisation would have had constantly to pause and halt, and it would be now far behind its present advanced position. We should, therefore, give to it an important position in the mental economy. This organ is sometimes so small, as a matter of inheritance, that no amount of effort will be competent to develop it sufficiently for even the ordinary purposes of everyday life. It is not reasonable to call people stupid or consider them dunces or ignorant because of any incapacity they may evince in this respect, for they may be extremely intelligent in many other directions. George Combe was an idiot in regard to figures, although otherwise a philosopher; while men who have been almost idiots in regard to numerous mental qualities have excelled at figures. Where this faculty cannot be cultivated to an ordinary extent, we may rest assured that it is owing to the inability of the brain; and, therefore, more especially in the case of children, we should feel how unjustifiable it is to expect the manifestation of a power that they do not possess. If, at the first, methods were used that would convert the usual task at figures into an exciting pleasure, we should have better calculators than at present. This can be done. In fact, all learning can be, and should be, made a pleasure.

Locality is situated above the organ of size. It reaches the middle of the forehead. The frontal sinus seldom interferes, therefore there is more certainty about it than about the organs of size and weight. This faculty remembers the situation of various places, and it has a more extensive influence than we are aware of. It is a great aid to memory, and, when large, prevents much trouble. One reads a book, closes it, and after—it may be a prolonged absence—returning to it, is able to find the exact place where the book was closed. Some people never think of putting a book-marker

in, or pencilling the page where they have ceased reading, while others, if they but lifted their eyes from the page for one brief minute, would find a difficulty in returning to it. Some people know the exact locality in which they leave things, while other people, because of this deficiency, are constantly losing things. These are states of mind that we must recognise. With an effort to train this portion of the brain, trouble might be saved, and energy more usefully expended. The faculty of locality enables us to remember places, such as various rooms and departments in a large house, hotel, or building, and enables us to find our way through the intricacies of stairs, corridors, lobbies, etc. Some people easily lose themselves amidst the streets of a large city, while others can go through a multitude of streets and return without the slightest hesitation or inquiry. The navigator requires this faculty in order to know his latitude and longitude, and for the study of the maps and charts requisite. It will likewise enable him to remember coast lines, headlands, and promontories; that is, to remember where they are located. Astronomers require it for the localising of the stars. It likewise gives a desire to travel so as to gratify the wish for seeing places, although there are other faculties to add to this desire.

HARD AND SOFT WATER.

The difference between "hard" and "soft" water is that the former contains in greater or less degree earthy salts, while the latter is nearly free from them and in a greater state of purity. The earth most frequently occurring in natural waters is lime. The quantity of earthy salts varies considerably in different instances. It is observed that when they exist in the proportion of five grains to a pint, such water will be hard and unfit for washing and many other household uses and manufactures. The solvent properties of water are the true causes why we never obtain this universal and important fluid in a state of absolute purity. It constantly participates in the properties of the manifold sources whence it is derived, or through which we obtain it. Whenever it is in contact with the soil it invariably dissolves the soluble constituents, and hence it follows that water springing from rocks which are only slightly soluble, as sandstone and granite, is very pure, and is called soft water, while that which is derived from calcareous formations is termed hard water, and contains lime, which produces an incrustation on the sides and bottom of the vessel wherein it is boiled. Pure water is known only to the chemist, for all the ordinary kinds of water contain either gaseous, saline, or organic matters. For chemical purposes water is obtained by distillation.

A NEW EXPLOSIVE.

Ecrasite, a new explosive, is the invention of two Austrian engineers, named Siersch and Kubin. Its power is stated to be in relation to dynamite as 100 to 70, and the new explosive is said to be capable of being carried from place to place with perfect safety. It emits a thick black smoke, and the detonating noise is louder than that of gunpowder, but shorter, sharper, and clearer. A bomb-shell loaded with it explodes with such terrible results that experiments against palisades, representing 100, 250, and 500 men at ranges of 300, 750, and 1,200 metres, are said to have recorded marks on every division of the palisade standing for a soldier. No details of the composition of this new explosive are known, as the secret of the invention is being closely guarded by the Austro-Hungarian War Office.

TIME.

If there is one simple scientific problem upon which more than on another people appear to get mixed that problem is time. Standard time, local time, sun time are exceedingly difficult questions for the public to puzzle over, and when sidereal time enters the calculation the case is hopeless indeed. We have frequently of late seen so many letters addressed the "Editor" of this and other journals, all touching upon one or the other of these chronological questions, that we have concluded a short note explaining the main points of difference would be, at any rate, timely.

Well, to come to time, the great chronometer and regulator-in-chief to the business, social and scientific world is the earth itself. Turning upon its axis in the period which we divide into twenty-four hours, the sun appears to cross the meridian of each place on the globe once in that interval. The moment at which it crosses the meridian of any place (Greenwich, for example) is termed "local apparent noon" at that place. This would be all very well if the earth and sun remained fixed in their relative positions; or if the earth, completing, as it does, an annual revolution about the sun, did so uniformly in a perfect circle and that circle were in the same plane with the motion of daily rotation. Then the successive intervals between the meridian passages of the sun at Greenwich would all be equal, and a perfect chronometer set at 12 hrs., 0 min., 0 sec, when the sun transited to-day would indicate precisely the same instant for "apparent noon" at every date.

But the earth's path round the sun is not a perfect circle; it is an ellipse, and the motion in one portion of the ellipse is more rapid than in another, and this causes a slight variation in the intervals between the solar passages. Again, the plane of the earth's path around the sun, or the elliptic, is inclined between twenty-three and one-half degrees to the plane of the equator in which the daily rotation takes place; and consequently twice a year the intervals of "apparent noon" are each about twenty seconds greater and twice a year about twenty seconds less than twenty-four hours. To explain just why this result, would require more of an investigation into astronomical principles than is here contemplated, but it is so, nevertheless, and any text-book will elucidate the reasons. A combination of the two effects causes the sun to be apparently slow fourteen minutes in one month and fast sixteen minutes in another. But in the course of a year the average comes out all right, and therefore a "mean solar day" of exactly twenty-four hours is adopted in the almanacs and used for all purposes. This accounts for the difference between mean time and sun time. A regulator keeps the former; a sun dial indicates the latter.

Sidereal time is a far more difficult subject, and a man who is following a plain every-day business life has no right to bother with sidereal time. It is the exclusive property of the astronomer. It is all right for the astronomer to tell us that from his determinations of sidereal time our sun time clocks are set correct, but that is his business. All we care to know is that it is literally "star time," determined by the interval between the successive meridian passages of any particular star; that this interval is three minutes fifty-six and one-half seconds shorter than twenty-four hours of a mean solar day. And perhaps it is very well for us to know that the cause of this acceleration is found in the fact that while the sun appears to rise and set 365 times in the year, any given star rises and sets once more frequently, on account of the annual revolution of the earth. And when we know this, and further learn that

although the comparatively near sun (92,000,000 miles away!) does not mark a regular interval of time by its diurnal revolution, the infinitely distant stars are brought with such precision into the tubes of the meridian circles, by the swinging around of this ponderous body on which we live, that the daily rotation of the earth can be measured with reference to them within the thousandth part of a second, that we are perfectly willing to accept the standard time which the astronomers give us, without doubt or question, and to give all due credit for the exactitude of modern ephemerides to the labours of those "who observe the stars by night."

Prizes for Everybody on Page 110.

THE COLOUR OF MUSICAL NOTES.

It is known to many, especially musicians, that some persons have a peculiar faculty by which the sound of certain instruments in an orchestra will produce in their minds an impression as of colour. So marked is this curious peculiarity in some people that they will, on hearing a trombone, or French horn, or clarionet, at once announce that they see certain hues, usually the primary colours. In a note to a life of Hayden, the composer, occurs the following: "Perhaps there is nothing in nature that is capable of being so well represented by sound as light." The answer of the blind man, who, on being asked what idea he had of scarlet, replied that it was like the sound of a trumpet, is less absurd than may at first be apprehended. It should be observed that the character of different instruments depends not only on the acuteness or gravity of their tone, but also on the degree of force with which sounds are produced by them. If, as Sir Isaac Newton supposed, the impulse upon the nerves of the eye produced by colours is similar in kind or degree to that produced upon the ear by sounds, the impression upon the sensorium, or seat of sense in the brain, will probably be the same, or so nearly so, that the ideas of the respective external objects will be associated in the mind. According to this theory the different musical instruments may be characterised by corresponding colours so as to be fancifully classed in the following manner:

Wind instruments—Trombone, deep red: trumpet, scarlet: clarionet, orange; oboe, yellow; bassoon (alto), deep yellow; flute, sky blue; diapason, deeper blue; double diapason, purple; horn, violet.

String instruments—Violin, pink; viola, rose; violoncello, red; double-bass, deep crimson red.

In the passage of "The Creation," which represents the rising of the sun, is an exemplification of this theory. Our attention is attracted by a soft streaming note from the violin, which is scarcely discernible till the rays of sound which issue from the first violin diverge into the chord of the second, to which is gradually imparted a greater fulness of colour as the violas and violoncellos steal in with expanding harmony. At the fifth bar the oboes begin to shed their yellow lustre, while the flute silvers the mounting rays of the violin. As the notes continue, ascending to the highest point of brightness, the orange, the scarlet and the purple unite in increasing splendour, and the glorious orb at length appears refulgent with all the brightest beams of harmony.

And there was light.

The burst of the whole orchestra in the resounding key of C, accompanied with all the harmony possible, and prepared by the gradual falling of the sounds, actually produce on us, at the first representation, the effect of a thousand torches, suddenly flashing light into a dark corner.

A BRAIN THEORY.

According to the former view of physiologists, the cerebellum (the hind, or little brain) was supposed to control combined muscular action, and to adjust the voluntary movements in an organised manner. But its similarity in anatomical construction and its close connection with the cerebrum, (the anterior or larger division of the brain), as well as its relation to the cords which conduct the sensations to the spinal marrow, have led the French naturalist, Courmont, to suppose that not only the organised workings of the voluntary motions are governed by the cerebellum, but that there also distinct spiritual occurrences have their seat. As is known, mental actions, such as thinking, reasoning, comparing, willing, etc., are performed in the cerebrum. Through a great number of observations, Courmont has reached the conclusion that the emotions, such as love, hate, anger, fear, joy, sorrow, etc., have their origin in the cerebellum; an opinion which was certainly expressed by Jessen as far back as 1869, but remained unnoticed on account of the want of proof. Its great similarity to the cerebrum in its finer anatomical relations is proved by physiological experiments; but still moreby clinical observations, several of which we will communicate. A lady who for some reason had lost her mental balance, answered all questions respecting the exterior world quite rationally, but became delirious as soon as her emotions were in the least disturbed. After her death, the cerebellum was found altered. If the cerebrum is considered as the only support of the mental occurrences, there must certainly be two different kinds of cells, one of which supplies the intellectual actions, the other the emotional, and any occurrence, such as a disturbance in the circulation, will influence one and not the other. On the contrary, occasional changes in the cerebellum, its diseased state or entire absence, as is often found out after death, are indicated during the entire lifetime by decided diseases of the feelings. This was shown in the case of a woman in whom the left half of the cerebellum was wanting, while the cerebrum and the spinal column were found to be entirely sound.

From her earliest childhood she was subjected to a certain timidity which, on the slightest occasion, manifested itself through weeping, wailing, and trembling, while her other feelings were entirely normal. In another case a disease of the cerebellum was observed in an 11-year-old girl; although she was mentally well-developed, she had never, in her life, experienced either pleasure or pain, and to all questions replied with "yes" or "no." A third case was met in a man about 40 years old. All his life he had been a great liar, thief, and idler, and immoral in the highest degree, and never had a friend, knew neither love, affection nor gratitude. While the cerebrum was entirely normal, the cerebellum appeared to be extraordinarily shrunken. In all these cases changes of the cerebellum or a great defect thereof were accompanied by great peculiarities of the emotions. But Courmont has further succeeded in supporting his opinion through an experiment: Ravens, which are extraordinarily timid, remain perfectly fearless after the destruction of the cerebellum. A study of comparative anatomy leads greatly to strengthen this opinion. The higher one mounts in the zoological scale, the greater the development of the cerebellum, which reaches its highest perfection in man. If it were only a means of muscular action, then the cerebellum should be extraordinarily developed in animals whose muscular strength and endurance are most remarkable, as in deer,

horses, hares, squirrels, etc., but squirrels have proportionally the smallest cerebellum. On the other hand seals, whales, dolphins and the ocean mammals generally, have a large cerebellum, and according to the unanimous opinion of eminent naturalists, these animals are exceedingly social, live in large families, protect each other in danger, and show great love and tenderness for their offspring. Among reptiles, on the contrary, the cerebellum is but slightly developed, and these are seldom social, are mutually aggressive and devour their young. Next to mammals, birds possess a proportionately large cerebellum, and these, as is well known, are very tender towards their young. In further proof of the theory, the nerves, which are supposed to express extremes of emotion, as the nerve of the tears and the great facial nerves, arise from the cerebellum.

THE PROGRESS OF SCIENCE.

In our opening number of Science Siftings we referred to the gigantic strides that science has been making in the last decade, and to the thousands of people that now take an interest in what was formerly to them a closed book. Actual figures relating to the extended interest in science that have come under our notice during the last few weeks, have still further astounded us. We have before us the lists of members of some of the leading scientific societies in the kingdom. These alone contain about 500,000 names. While it is not beyond the mark to say that there are another 500,000 scientists in embryo—*i.e.*, in the student stage. In a minute just issued by the Education Department dealing with the subject of the examinations of the Science and Art Department in science, it is stated that the number of candidates presenting themselves for examination in science is already so large—about 190,000 papers in various branches of science were worked at the examination in May last, besides above 14,000 practical examinations—that the machinery of examination and registration is already severely strained. These numbers, according to the minute already quoted, will in all probability soon be increased. We are decidedly in unison with this last opinion. We have already shown that a *million* of scientists pure and simple exist either as members of scientific societies or as students, but we estimate that there must be at least another million of people directly interested in science through relationship or social intimacy with those who are directly connected with it. Beyond these, we calculate a million *dilettantes* who like to know all that science is doing. Thus, we have *three millions* of people more or less interested in the logical perfection and interesting truths of science. A number of intelligent, active, working, and thinking people equal in bulk to the whole population of Scotland—men women, and children of all classes included.

A NEW USE FOR TELEPHONES.

The telephone may be used for foretelling storms :—By placing two bars of iron at 7 or 8 yards distance from each other, and then connecting them on one side by a copper wire covered with rubber, and on the other side with a telephone, a storm can be predicted at least 12 hours in advance by the sounds heard through the receiver. The sounds are said to be like those produced by hailstones thrown against glass, while each lightning flash produces a shock like that of a stone thrown against the diaphragm of the receiver.

TO INVENTORS.—Anyone having a good Invention can, on applying to the Editor, "Science Siftings," obtain the advice and assistance of a well-known Patent Expert, free of charge.

THE FAITH OF INVENTORS.

Unshaken faith in their ideas and a determined perseverance to overcome obstacles, are gifts with which inventors have been endowed, or, in common parlance, they have their inventions "on the brain"—mount their hobbies and ride them continually. If they were influenced by rewards, or hopes of reward ultimately, it would seem, in the eyes of the world at large, that there was a "method in their madness," and that the tangibility of wealth was the terminus of the "hobby" race. But we find a large proportion of inventors unbiassed and uninfluenced by any hope of wealth, money, or reward. They labour and experiment as though their existence depended upon it ; they labour with the hope only of ultimate success in accomplishing what they proposed to perform, and that labour is with them a labour of life and love. This labour is ever constant to their minds, ever uppermost in their thoughts, ever exerting itself in every movement and every action. They are determined in overcoming every resistance. It is an example of the power of mind over matter—of intelligence over the powers of nature.

And what does the world not owe to inventors ? Civilisation, arts and commerce are the fruits of the inventors' "hobbies," and the greater part of these fruits has been the product of toil, many years of labour, at a cost of life, privation, and poverty ; yet such was the inventors' faith that all obstacles have been overcome, and often after the results are obtained the fruit is left for others to mature and gather. Galileo declared the world "did move," and a prison was the result. Columbus, on the eve of his discovery, was nearly being thrown overboard by his discontented mariners. Harvey, the discoverer of the circulation of the blood, and Jenner, who first practiced vaccination, may be cited as examples of how great discoverers may be treated by the world before their discoveries are appreciated. Among the mechanics of a later day, Fulton, who was declared crazy ; Colt, who had to mortgage his little stock of tools to obtain money to make his pistol ; Goodyear, patiently toiling to obtain his results in the manufacture of rubber ; Howe, bravely meeting all adversity to finish and introduce the sewing machine, may be cited as a few—very few—examples of struggling but afterwards successful inventors. The list might be extended almost *ad infinitum*. Yet when success is achieved and the true value of the invention appreciated, the tardy meed of praise is tendered to the persistent faith of the inventor who accomplished the results.

Nor are poverty and adversity all that tries the inventor's faith in his projects. The ridicule of the masses, and the sneers of the ignorant, are perhaps as great discouragements as the former. Want of appreciation must be the only excuse for such undeserved and unmerited echoes, which rebound upon the faith of the inventor.

We might say that all workers are inventors, few in the extreme, but all in a degree. He is an inventor who produces a cheaper product or goods of a better quality—who brings about a better result ; he who simplifies a process—who modifies proportions of ingredients, or he who excludes an unnecessary portion from a machine, producing like results with fewer parts and motions. Anything of benefit to humanity is invention, and the author or producer is an inventor. A test of invention is the faculty to adapt means to an end without complexity, and an ability to advance human knowledge. Faith in this ability is omnipotent and tantamount to success, and this success is purchased with self-sacrificing and energetic action, and a zeal to introduce the blessing of the results of their inventions and labours.

It is well the inventor has faith in the project of his brain,

and the prospect of ultimate success is ever before him, and the dream of each night is that the morrow will produce the brilliant results which his dreams have depicted. It is well that it is so ; for were it otherwise—were there no inventors —the world would be even now a barbaric chaos.

SOMETHING ABOUT STORMS.

A learned meteorologist has adduced the following reasons for some recent severe storms:—Suppose a network of wires like an ordinary fishing net were spread over the whole surface of the earth, 20 feet from the ground. Let another net be spread above this, and so on to the height of five miles, and what will happen ? In no part of the whole earth would a cloud be seen, for the reason, as will appear by the following explanation, no cloud could possibly be formed. Here are two cannon balls. Place them a foot apart, far off into space and beyond the influence of any planet. Now electrify both and watch the result. Like electricities repel, and they will fly away from each other with lightning speed. But suppose one generates electricity in itself. This will electrify the other ball, and when the latter flies off and loses its electricity it will return to the electric ball. Again it will be driven off, and so it will go on forever. The meteorologist made this explanation with regard to the sun and comets in 1864, and he has worked a quarter of a century to convince the world that the sun is electricity. He succeeded, he says, and it may take him, he thinks, as long to convince people that wires cause droughts and disastrous cyclones.

But suppose the two iron balls to be replaced by two minute particles of water. Electrify them and they will stand apart. Take away the electricity suddenly, and they will rush together by the force of gravity and form a single drop. A cloud is formed of aqueous particles kept apart by being electrified. Remove the electricity, and they will in the twinkling of an eye form a ball of water which will fall like a stone and produce a cyclone. True, the electric wires do not suddenly exhaust the cloud. Had they done so the city would have been partially, and possibly wholly, demolished. When the aqueous particles are congealed they occupy a larger space, but the effect is a snow storm borne along upon a hurricane. Cities and towns on the seacoast which are covered with wires, and those near mountains where electric clouds form, are exceedingly liable to these dangerous atmospheric disturbances.

It is evident, then, if electric wires destroy clouds and precipitate the humid particles of which they are composed, those parts of the country traversed by wires must deprive others of the grateful showers nature has stored for them. Forests are gentle conductors, and gradually break the clouds passing over them and produce moderate rains. Sand is a non-conductor, and hence no rains fall on the desert. Pierce them with railways, the clouds will greet the smoke of the engine and make the desert bud and blossom as the rose.

France, Italy and Spain are being covered by wires, and the deadly cyclone, hitherto almost unknown in those countries, has taken its seat upon the Alps, Pyrenees and Appenines and has begun its work of desolation and death over the plains below. This will go on increasing in both hemispheres till the public will come to believe the old theology that Satan has possession of the elements. In 1887 our informant advised that no wire fencing should be permitted in Manitoba or on the Northwestern plains. His advice was not acted on—probably could not be—and as a result, during the past summer, hail and cyclone for the first time destroyed a large area of the grain crop in these regions.

CURIOUS EATERS.

The sea urchin has five teeth in five jaws—one in each jaw—all the five immediately surrounding the stomach. The jaws have a peculiar centralised motion, all turning downward, so that they also act as feeders.

Snails have teeth on their tongues, hundreds of them, but, as if these were not enough, some have them also in their stomach.

The cuttle-fish, which among other strange things always walks with its head downwards, does not chew its food at all, but masticates with its gizzard.

The ray, or skate, has a mouth set transversely across its head, the jaws working with a rolling motion like two hands set back to back. In the jaws are three rows of flat teeth, set like a mosaic pavement, and between these rolling jaws the fish crushes oysters and other molluscs, like so many nuts.

The carp's teeth are set back on the pharynx, so that it may be literally said to masticate its food in its throat. The carp, too, is about the only cud-chewing fish, the coarsely-swallowed food being forced up to these throat teeth for complete mastication.

Some fishes are absolutely toothless, like the sucker and the lamprey; others again have hundreds and hundreds of of teeth, sometimes so many that they cover all parts of the mouth.

The great Greenland whale has no teeth, its baleen plates, or whalebone, taking their place. Along the centre of the palate runs a strong ridge, and on each side of this there is a wide depression along which the plates are inserted. These are long and flat, hanging free, and are placed across the mouth with their sides parallel and near each other. The base and outer edge of the plates are of solid whalebone, but the inner edges are fringed, filling up the interior of the mouth and acting as a strainer for the food, which consists of the small swimming molluscs and medusæ or jelly-fishes.

While the Greenland whale has no teeth, the sperm whale has them in great quantities on the lower jaw, and uses them, too, when occasion requires. On the other hand, the narwhale very seldom develops more than one, the left upper canine. It makes up for the lack of numbers by the extraordinary growth attained by this one tooth. It grows out and right forward, on a line with the body, until it becomes a veritable tusk, sometimes reaching the length of ten feet.

The river dolphin of South America has 222 teeth.

The sturgeon is toothless, and draws in its food by suction, but the shark has hundreds of teeth set in rows that sometimes number ten.

Lobsters and crabs masticate their food with their horny jaws, and they have also sets of teeth in their stomachs, where they complete the work of chewing.

There is one peculiar kind of crab, called the king or horse-shoe crab, which chews its food with its legs. This is an actual fact, the little animal grinding its morsels between its thighs before it passes them over to its mouth.

The jelly-fish absorbs its food by wrapping itself around the object which it seeks to make its own. The star-fish is even more accommodating. Fastening itself to the body it wishes to feed on, it turns its stomach inside out, and enwraps its prey with this useful organ.

The clam feeds with a siphon, and the oyster with its beard.

Prizes for Everybody on Page 110.

PERPETUAL PRIZE COMPETITION.

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SCIENCE NEWS AND NOTES.

"A dwarf sees farther than the giant when he has the giant's shoulders to mount on."—COLERIDGE.

The Five Guinea Prize Competition

for the best article on "The Condition of Man in 1991" is now closed. We have received so many articles, and all of them are more or less lengthy, that we cannot hope to publish the award much before Christmas. We shall do so, however, as early as possible, and in the meantime we ask the indulgence of our readers for any delay. The task of wading through so much manuscript is truly an Augean one.

Influenza,

according to the panical nonsense published in the daily press, has already taken a strong hold of the community again. We have every reason to believe, however, that our contemporaries have vastly over-painted the picture, and that the epidemic is not nearly as bad as described. Apart from our own observations, the *Lancet* tells us that there is a noteworthy difference between the present outbreak and those experienced last spring and the original epidemic of the winter of 1889-90, and that difference is in the comparative slowness of its diffusion over the country. It is mainly confined to two widely separated parts of the kingdom, viz., Cornwall and the eastern counties of Scotland. It is remarkable, however, that children are being attacked almost as much as adults. Abroad it is reported to be very prevalent in St. Petersburg and Berlin, whilst at Hamburg it was also reported to have reached "alarming proportions," and the weekly mortality of the city and its suburbs exceeded the average by 280. In France it is especially prevalent at Bordeaux, where many deaths among the aged have occurred. It has also appeared in Paris. It is, however, misleading to say that influenza is epidemical in London or even in England, and we counsel our contemporaries not to frighten the public into the disease as they have been doing. Fright may even do more harm than influenza.

The Cold Water Cure

is somewhat less popular in England than it was a few years ago. Probably this is rather due to the tendency of all so-called "crazes" to come to an untimely end than to any want of efficacy in the cure. There is a little village called Woerishofen, between Memmingen and Augsberg, in Bavaria, where the wonders effected by cold water attract thousands every year. Abbé Kneipp is the Æsculapius who dispenses blessings at this primitive little place. He believes that water will cure all the ills to which flesh is heir, and as he resolutely refuses to charge for his advice and assistance, notwithstanding that he could make a fortune by so doing, his patients are not a few.

Marvellous Cures

are reported. A man whose face was disfigured by a horrible cancer recovered his normal condition after a few weeks' treatment. The blind are said to have regained their sight and the lame have walked. According to the Abbé, every disease originates in the blood; there may be a disturbance in its circulation, there may be a derangement of its composition. Water alone can act thoroughly on the blood, and water produces four noticeable effects. It dissolves the injurious principles of the blood, eliminates that which has been dissolved, restores regular circulation to the purified blood, and fortifies the debilitated organism. In a talk with the Abbé after consultation hours he said that fifty years ago people did not take cold as at the present time. Why? Simply because the body was more hardened to changes in temperature. Water makes the body capable of enduring all climates, and the best way to begin the treatment is to walk barefoot in the wet grass. After a quarter of an hour's promenade without drying the feet, one must put on dry shoes and stockings and exercise until the feet are very warm, "If you can find no dew, no wet grass," said the Abbé, "walk on cold, wet stones, or even on the snow. That is my remedy for those who are always taking cold."

The Treatment Varies

according to the malady. For some he prescribes vapour baths, for others wet compresses, for others baths with oats or hay added to the water, etc. The water must be cold as

possible, and in winter snow is preferred. But a cold bath must never last more than five minutes, including the time required for dressing and undressing, and the bather must never use towels, but always exercise for fifteen minutes after the bath. Friction only causes unequal circulation, but exercise produces a uniform heat. Warm baths should always be followed by a plunge in cold water. The good Abbé says one must never drink too much water, and the least possible during repasts. "Drink a little water before eating, very little while eating, and two or three hours after, drink as much as you wish." Of course, there may be something in the climate of Woerishofen that helps the Abbé in his cures, and we cannot say that we advise anyone to follow his precepts, in this country, anyhow. His favourite maxim is: "A very little salt, not too much vinegar, no tobacco, three meals a day, seven hours of sleep, and a thorough acquaintance with water will make you live 100 years, and then you will die happy, for death alone cannot be cured." Of course, the Abbé was prosecuted for practising medicine illegally, and in reply to the charge he answered: "When I see people ill, with no money to pay a physician, can I do otherwise than attempt to alleviate their sufferings?" He was acquitted; and as his fame had spread far and wide invalids came from all quarters. But now the Abbé is allowed to cure all who ask his advice.

Bald Heads

as we have pointed out on the authority of a specialist, may be greatly affected by diet. Another medical man now writes: "The scalp and the stomach are so closely connected that the condition of one easily exerts a strong influence on the other. Hair falls out because the scalp is feverish. A man who loves to eat and drink the best he can get is very apt to have a feverish stomach. If he keeps this up the fever is permanently imparted to the scalp and the hair falls out. Show me a rosy-cheeked man with a bald head, and I'll show you a person who loves to live well, and who has an inexhaustible fund of good nature. They like fun and excitement and for that reason can often be found in the front rows of our theatres."

Electricity and Nitrogen

are two words which are seldom seen in apposition but they represent two of the most potent agencies in the universe. Nitrogen is one of the most valuable and at the same time the most abundant elements. About three-quarters of the atmosphere is composed of nitrogen, and it enters as the principal article of food into all animal tissues. There is thus in the air above the earth a greater store of wealth than ever was or ever can be dug from all the mines under the earth. But how to make use of this treasure is the question. In its pure state nitrogen is of no value as a food supply for either plants or animals, and cannot be applied in the arts. It is pre-eminently the most inert substance in nature, and only combines with other elements by the most roundabout processes.

The Philosopher's Stone

was sought in vain by the alchemists of old, because it was to convert the baser metals into gold, but the modern scientist should search for the key to this nitrogenous riddle. Why should any one starve while the very air we breathe teems with food supply? If any man ever subdues this wayward element it will be an electrician, and why? Because by means of an electric spark the nitrogen of the air can be caused to combine with oxygen in such proportions as to form nitric acid. The production of nitric acid by electricity sounds like one of the discoveries of the nineteenth century, but such is not the case, for by every flash of lightning a small portion of nitric acid is formed. If electricity can force nitrogen into one compound, why not into another? Here is a field in which electricity may some day give another manifestation of its wonderful power.

The Lightning Flash

is capable of conveying other hints to us than the one just referred to. Probably the first glass which was ever produced on earth was made by electricity. The lightning tubes which are familiar to geologists are really composed of glass, having been formed by the melting of the silica in the sand by a discharge of lightning. It is possible that some day the conflict between gas and electricity may be extended into the glass works.

The Effect of an Electric Discharge

upon oxygen is no less interesting than in the case of nitrogen. Oxygen so treated seems to undergo a complete change of properties. Instead of being a harmless gas without odour or effect on delicate colours or organic compounds, it acquires a pungent odour and rapidly rusts metals and bleaches the most permanent dyes. Electricity thus becomes a powerful agent in bleaching, and, acting indirectly through ozone, may become in a new way an important factor in medicine. Ozonised oxygen, while not recognised as "officinal," has such a marked effect on organic structures that it has been looked upon with favour by many physicians, especially in diptheritic affections.

Quacks

have, of course, seized upon electricity as a means to a golden end—golden in a double sense. We learn that a certain barber is constructing an electrical apparatus for making ozonised oxygen to be used in dyeing the hair. By this means he would avoid the use of dangerous dyes. In another case a manicure is perfecting a system of tanning the face "while you wait," producing by means of an arc light and a focusing lens (which is gradually moved about over the face) all the nut-brown effects that are usually associated with health, travel, or aristocratic idleness.

Edison

is finding out some new secrets about sound vibrations every month. His phonic inventions are the utilisation of sound vibrations—one to communicate them, another to impress them on a wax cylinder. It is highly probable that the deaf can throw some light on the mysteries. Their experiences are altogether different from those of persons who can hear They detect the presence of sounds in the air through the nerves, but the degree in which they feel the vibrations depends upon where they stand or sit. A wooden building or a wooden floor echoes with sound. A stone floor will not communicate sound to them. Again, in a silent street they know when a waggon is passing, and sometimes can tell what sort of a waggon it is. But in a crowded street, where many vehicles are passing, they are not able to distinguish the sound of one or all of them.

A Telephone to the Sun

is one of Edison's great hobbies. There is in the New Jersey mountains a vast mass of iron a mile long and of about the same width which runs straight down into the earth for a number of miles. The ordinary telephone is made by running a wire around the top of a magnetic bar,

and this machine when charged with electricity enables us to register the sounds which come in contact with it. Edison is using this immense natural bar of iron of the New Jersey mountains as the basis of his telephone. He has wound miles of wire about its top and has formed an inductive circuit in which he will have the most powerful of electric currents. He expects through it to hear the noises made on the sun and the explosions which are supposed to be constantly going on there will be easily audible. He has been working at the matter for some time and has it just about ready for testing. We referred to the possibilities of this scheme in our third issue.

Perfection has not been Attained

as far as the telephone is concerned by a long way, Mr. Edison thinks. He is of opinion that long distance telephoning is growing, and the only restriction of the possibilities of the telephone is in the sympathetic contact of the electrical wire with the rest of nature. If a single wire could be placed so high above the earth that it would not touch the mountain tops, you could whisper around the world, and you could sing a song in London and have it heard in Pekin. Wherever we get the wire comparatively free from contact with the earth distance seems to make no difference, and on a line a thousand miles long over a treeless country in Arizona a better telephonic connection is obtained than between New York and Philadelphia, which is a comparatively trifling distance. If we could have a telephone from the earth to the sun—that is, a wire—we could send sounds there with perfect ease, and with the phonograph, were our language universal, we could make a speech here and have it recorded and reproduced in any of the great planetary bodies.

The Inventions of the Next Fifty Years

will outshine those of the last fifty, if Mr. Edison's prognostications be correct. We are discovering new principles, new powers, and new materials every day, and no one can predict the possibilities of the future. Take electricity. When we get electricity directly from coal, a lump as big as a tumbler will light and heat a whole house for hours, and a basketful would run a factory a whole day. In the generation of steam we only get 14 per cent. of the energy of the coal. In electricity we get 96 per cent. When we get our electrical power direct from coal a few hundred pounds will carry you across the Atlantic, and a few basketfuls will take a railroad train for a very long journey. Mr. Edison believes this to be one of the great problems of the future, and he has no doubt but that it will be solved. He has been working on it for years, but he has not accomplished it yet. When it does come it will revolutionise everything. It will cheapen everything, and it will be the greatest invention of modern times. As it is now, we have to burn the coal to get the steam, and the steam gives us the power which runs the dynamo and produces the electricity.

The Stomach is a Chemical Laboratory,

and Mr. Edison considers digestion as merely a chemical operation. Like all wise men, if he finds that his stomach is not working rightly, he knows that the right chemical action is not going on inside of it, and changes his food. If he has been eating meat he drops flesh foods altogether and confines himself to vegetables, and in a short time he is all right again. If he has been eating more vegetables than meat, he drops the vegetables and the meat brings him back to his normal state. The great electrical wizard is, undoubtedly, endowed with much common sense.

Sleep

is another subject that Mr. Edison discusses very sagely. He does not believe that man needs as much sleep as is generally supposed. He thinks we sleep too much and eat too much. Six hours or six and a half are plenty for him and he seldom takes more. If he sleeps eight hours, he finds that after breakfast he wants to go to sleep again, whereas five hours puts him in splendid condition. Edison inherits a very good constitution. His grandfather lived to more than 100 years of age and his father is 92. Neither of them were long sleepers, and he thinks sleep after all is more of a habit that anything else, and that in the far future, if we should have an artificial light which would make the world like day, year in and year out, we would never sleep at all. We go a long way with this ingenious philosopher, but hardly as far as this.

The Days of Alchemy

are again upon us. A gentleman, needless to say of American origin, has submitted to the French Academy of Sciences several bars of metal which he claims to be artificial gold. This august assembly has turned its electric search light full upon this discovery and condemned it, with extenuating circumstances. The verdict of the Academy is that these samples are in reality only an agglomeration of metal precipitates that under the action of certain phenomena, as yet little known, and among which light plays an important role, assume a yellow colour and the characteristics of gold. The analysis of the metal by the Academy has demonstrated that the gold is ninety-seven parts pure silver with traces of citric acid and iron. The Academy has further demonstrated that this combination is unstable. It is only necessary to give it a blow with the hammer or submit it to the action of intense heat to see the yellow tint, characteristic of gold, disappear and the metal resume its colour of silver.

Another Alchemist

is known in Paris as Monsieur Theodore Tifferean. He claims to have discovered his method in Mexico under certain conditions of light and heat which he cannot produce in France. He explains his process thus: Eight or ten grains of silver and copper were reduced to a powder, by filing, put into a small vial and covered with nitric acid. The vial was then exposed to the sun and a lively reaction took place. Vitreous gasses escaped in abundance and a black deposit formed. This mass was left for twelve days and then a little distilled water added. The vapour continued but no precipitate formed. The seventeenth day the whole mass was boiled and afterwards baked to a greenish mass. Over this some boiling nitric acid was poured. The colour became more and more green, then dark yellow, then yellow of gold, and, finally, disintegrated and became a powder. The old man claims that if he had a laboratory he could turn this gold out in quantities, but, unfortunately, people will not believe in him, and perhaps, like Galileo and many another, the justification will come when he departs this world.

Prognosis,

according to a recent writer, may be defined as the judgment found by the reasoner regarding the future progress and termination of the subject or thing upon which he reasons. This judgment is based upon facts that have previously occurred, that are occurring constantly about us and that probably will continue to occur in the future. Reasoning in this way we can determine with great accuracy and precision the prognosis of a disease, of a nation, or a planet, or of a universe. We naturally inquire, then, what is the

prognosis of the earth upon which we live. Is it to go on indefinitely in its present condition as the abode of animal and plant life, or will there come a time ultimately when all forms of life will cease as a result of terrestrial changes that will make life impossible? From what we know of the changes that are slowly taking place, the latter view is the probable one. Our earth circles about the sun at such a distance that the supply of light and heat received from him is extremely favourable to the continuance of animal and plant life. This supply of light and heat is stored and reserved by the envelope of atmospheric air surrounding us. Were it not for this envelope of air the direct rays of the sun would blind and scorch us by day, and at night we should be plunged in destructive cold by the radiation and dissipation of the heat into space. We have reason to believe that such a change, although upon a much smaller scale, has taken place in our satellite the moon, which now circles about our earth an opaque mass of insensate stone.

Science Teaches

us that changes are slowly taking place in the condition of the envelope of the atmosphere surrounding our earth. These changes consist in a gradual attenuation of the air through a loss of one of its constituents—oxygen. If this is true—and there seems to be abundant evidence to sustain the view—a time must inevitably come, in the far distant future, when this attenuation will reach such a point as to make the air inadequate to carry on the process of animal respiration through its loss simply of oxygen gas. When this point is reached animal life must cease altogether. Plant life may continue, however, for a considerable time after animal life has passed away, and until the time arrives when the attenuation of the air has reached such a point that it cannot hold a sufficient quantity of carbonic-acid gas to sustain it ; then plant life must cease also. As this attenuation of the atmosphere goes on, the ocean will be slowly dissipated until it no longer exists, and in the still later future the earth will reach the condition in which our moon now is—a mass of dry, barren rock, without any vestige of life upon it. After an interval of time of long duration, natural causes will compel the whole universe to coalesce and become one body. This under the stimulus of chemical law, will separate and form a new universe of suns with their attending planets, which will again pass through the same phases and the same changes that our universe has passed through and that our earth has passed through. Then another evolution of life will follow, and new animals and new plants will arise and pursue the same path of development, that ours have done. They will flourish for a time in a world as bright and beatuiful as ours, and after reaching their highest point of development, slowly decay and finally return to their original elements.

Sleeping Oneself Fat.

is a common enough complaint, as must be self-evident to the lazy. Almost every young man who has lived leisurely all his life until he is 30 will begin to show signs of fat at that age. The usual theory that obtains is that a man only grows fat on the food that he consumes, and technically that theory is all right. But it makes all the difference in the world how a man lives whether a given amount of food taken daily will have any increased effect on his avoirdupois. There are the three simple rules to enforce on men who complain of fat. First, "Eat less." Then, "Work more." And then, "Sleep less." We have often noticed a curious look in the eye of the patient who is told to sleep less. He inwardly jests at such advice, or he grumbles against it, and concludes that it may be disregarded. But sleep will produce flesh more rapidly than anything else that we know of. There have been very few fat men that did not sleep too much. It piles on the flesh with surprising rapidity. And the worst possible practice for a fat man who wants to get thin is to sleep during the day.

Electricity is Life,

is the new creed of the electricians. It is argued that it is possible, if it is not at present demonstrated, that electricity may be the active principle in the processes of animal vitality, and that the relation between electricity and vitality may be so close as to amount to identity. This is perhaps pardonable in electrical enthusiasts, but it is doubtful if any eminent physiologist or psychologist will allow that nerve-fibres do more than artificially resemble insulated wires, or that a dynamo can confer any degree of immortality.

The Sound of the Aurora

formed the subject of comment in a recent issue. Mr. Henry J. Webber, a gentleman connected with some excellent institutions—scientific and otherwise—writes to us that he was only aware a few years ago that there was any contention among scientific men respecting these sounds. He has personally made several voyages to Canada and has had the good fortune to see some brilliant displays in the Gulf and River St. Lawrence. One in particular was very remarkable, and perhaps phenomenal. We give the details in the writer's own words. "We lay at anchor midway between Quebec and Montreal. It was a lovely summer night, very calm and remarkably quiet, and we witnessed an auroral display in its full splendour. Nearly the whole of the sky, from the horizon to the zenith, was covered by it. Enormous streamers were being continuously shot out, and were accompanied by a sharp crackling sound, very similar to that which is caused by certain powerful electric experiments. The sound was by no means subdued, but I cannot say it was absolutely loud, for it might give one an exaggerated idea of it. The display lasted several hours, and was at a very short distance from the earth. Mr. Tunzelmann says, 'There is still another phenomenon connected with the polar lights, viz,, the abundant falls of rain or snow which have always been noticed during the prevalence of an aurora.' I may state that neither this display nor the others I have witnessed were preceded or followed by rain. Being unaware of the importance of it, I did not record it in my note book, but I fancy it took place on July 31st, 1883. On that occasion I was on board the ss. "Scotland," owned by Temperleys, Carter, and Darke, 21, Billiter-street, to whom I am well known. It is, of course, important to have a report like this verified, but this will take me a long time to do, as I learn that the officers are scattered and are all at sea."

The Temperature of the Air,

instead of being warmer in the higher regions, is actually colder, if we may rely on some experiments made by Herr Ham, a Viennese meteorologist, who has made simultaneously some comparative thermometric observations at various altitudes. This destroys the theory that cyclonic disturbances are due to the rise of a current of heated air, its place being supplied by colder air, which rushes to fill the void thus created.

THE PRIZE SCIENCE SIFTING.

One Guinea will be paid each week to the contributor of the most interesting or curious Science paragraph.

The paragraph must not exceed 200 words, and need not be original, but in this case, the source from whence it is copied must be given. All paragraphs must reach us on Monday, and be marked "Prize Science Sifting" on the envelope, unless a postcard be used. Only one paragraph may be sent in by each competitor.

The Editor reserves the right of publishing any paragraphs sent in.

We have awarded the prize of One Guinea to Mr. JOHN GAWTHORPE, c/o The Rt. Hon. W. L. Jackson, M.P., Baslingthorpe Tannery, Leeds, for the leading "Science Sifting." The other siftings published all deserve honourable mention.

The Organ of Equilibrium in Man.

THE cerebellum, or as it is generally called, the "little brain" inside the larger brain of man, is the organ of equilibrium, by which we judge of all our relations with the external world and maintain the erect position. It is closely connected with three semi-circular canals filled with limpid fluid, and set at three different angles, like spirit-levels, which are connected with each ear. The varying pressure in these is supposed to inform the city arab when he is standing on his head or turning cart-wheels. The cerebellum is readily poisoned with alcohol, hence the drunken man cannot stand. Different spirits are indeed believed to affect the different canals, so that if it be beer or wine the man tends to fall sideways; if whisky, on his face; if perry or cider, on his back. A combination of the three that would keep him straight seems theoretically possible, but hitherto such a mixture only succeeds in making him "all of a heap."

Perpetual Motion.

CONCEIVE, says Sir Robert Ball, a terrific cannon capable of receiving a round bullet not less than 2,000 miles in diameter. Discharge this enormous bullet with a velocity of about 3,000 feet per second, which is two or three times as great as the velocity actually attainable in modern artillery. Let this notable bullet be fired horizontally from some station nearly a quarter of a million miles above the surface of the earth. That fearful missile would sweep right round the earth in a nearly circular orbit, and return to where it started in about four weeks. It would then commence another revolution, four weeks more would find it again at the starting point, and this motion would go on for ages. Here we would have perpetual motion governed by the law of gravitation, as in the solar system.

John Edwards, 43, *Calvert-road, East Greenwich.*

The Tonsils.

THE Tonsils have for some years been a puzzle to men of science, they have found that on removing them no permanent injury results. It has been shown, however, that their function in the animal economy although generally unknown is an extremely important one. It has been ascertained in recent years that they give rise to a number of amoeboid cells in the saliva, and that these cells swallow all injurious substances which enter the mouth with the food, all the pathogenic organisms, i.e., disease germs, and that these cells in their turn, together with their burden, are swallowed by larger, but similarly constituted cells. It has been ascertained by direct experiment in Sheffield, on those engaged in steel and iron work, that these cells of the tonsils become full of steel particles. Dogs are animals noted for poking their noses into all sorts of dirty holes and corners, and it is found that their tonsils are full of dirt and disease germs.

P. F. J. Corbin, 16, *Spring-street, Hyde Park, W.*

Edison's Theory of Existence,

It is my belief that every atom of matter is intelligent. The intelligence of man is the sum of the intelligence of which he is composed. Every atom has an intelligent power of selection and is always striving to get into harmonious relation with other atoms. The human body, I think, is maintained in its integrity by the intelligent persistence of its atoms, or rather by an agreement between the atoms so to persist. When the harmonious adjustment is destroyed a man dies, and the atoms seek other relations. I cannot regard the odour of decay but as the result of the efforts of the atoms to dissociate themselves, they want to get away to make new combinations. Man, therefore, may be regarded as a microcosm of atoms agreeing to constitute his life as long as order and dicipline can be maintained. But of course there is disaffection, rebellion, and anarchy, leading eventually to death, and through death to new forms of life. For life I regard as indestructible; that is, if matter is indestructible. All matter lives, and everything that lives possesses intelligence.

J. Stopherd, 17, *Abingdon Street, Toller Lane, Bradford.*

A Brain Phenomenon.

A celebrated chess player named Mr. Rookwoode died about twelve months ago, he was able to play twelve games at once blindfold, and sometimes attempted fourteen, but the two extra games proved all but failures. After his death, the brain of this gentleman was examined by his brother Dr. Rookwoode, a skilful anatomist. By aid of the highest power the microscope could supply, the phrenological organ of "locality reavealed the astonishing fact that the molecules had arranged themselves into forms somewhat resembling chess boards, with certain marks on the squares supposd to represent the final position of the pieces in the twelve games that had been played blindfold. The thirteenth and fourteenth boards or what might represent them were blurred and indistinct, thus accounting for the fact that these two extra games always embarrased the blindfold player."

G. B. Coleman, 3, *Leppoc Road, Clapham S.W.*

Quartz Fibres.

A Spider's thread is the slenderest thing to be found in nature, far finer than even the thread of the silkworm, and for this reason it is used for the cross hairs of telescopes; special species of spiders remarkable for the slenderness of their threads being indeed preserved for this purpose. But here at least science has beaten Nature. Mr. C. V. Boys, F.R.S., has devised a means of spinning threads so fine that they are invisible under the most powerful microscope. A piece of rock crystal or quartz, which melts at a temperature far higher than that of a blast furnace is fused by the oxy-hydrogen blowpipe, and a little arrow fired from a cross bow draws out a thread of quartz. This thread is stronger than steel, and as before said, can be drawn so fine that it is absolutely invisible. These threads of quartz are rapidly replacing the relatively enormous fibres of raw silk so much used for suspension purposes in the physicists laboratory.

H. E. Haycroft, 48, *Breakspears Road, Brockley, S.E.*

FUNGI are very numerous. At least 12,000 species are now ascertained to grow in our islands, while in the world at large, Dr. Cooke gives the total as 30,000.

GLEANINGS OF THE GLOBE.

HABITUAL divers in salt water often have inflammation of the eyes.

AN investigation in Switzerland shows that mortality from organic disease of the heart decreases as the altitude of the habitation rises, and that it is greater in towns than in the country.

IT has been noticed in France that those persons engaged in cleaning out the apparatus used in refining petroleum are subject to a skin disease resembling the cancer of chimney sweepers.

PROF. JOHN MACOUN contends that any given plant is more productive when approaching the northern boundaries of the area it occupies than when it is approaching its southern line.

AN invention for factories enables any person in any part of the factory to stop the main engine by the touching of a button, the wire connecting with the engine governor. In cases of mishap this is a very useful device.

CERTAIN plants in Mexico and South America produce what are called "jumping beans." The beans jump about, and their movement is derived from the larvæ of a moth which lodges in them.

THE hottest region on earth is in the south-western coast of Persia, where Persia borders the gulf of that name. For forty consecutive days during the months of July and August the thermometer has been known not to fall lower than 100° Fahrenheit night or day.

THERE is a tract of forest trees in Southern Oregon embracing about 16,000 square miles, which, cut and sold at 10 dollors (£2) per 1,000 feet, would pay the national debt twice over. It is estimated that the amount of merchantable timber standing will reach 400,000,000,000 feet.

UNCLE SAM'S dominion extends a little more than half way around the globe. The distance from the eastermost point in Maine to the westermost island of the Behring sea is a little more than one hundred and ninety-six degrees of longitude, so that it is full sun up in Maine before it is sundown in Behring sea.

M. EIFFEL is now utilising his famous tower and a balloon for aerial telegraph purposes by night. It is intended to ascertain by the experiments at what distances the lights on the tower can be perceived from a balloon, and to what height from the summit of the tower an aerostat can be seen and communicated with by signals.

SIR ISAAC NEWTON is said to have carried in his ring a magnet weighing but three grains, which could raise 746 grains or 250 times its own weight. This magnet naturally excited much admiration, but is surpassed in power by that formerly belonging to Sir Julian Leslie, and now in the Physical Collection of Edinburgh, weighing three and a half grains, and having a carrying power of 1,560 grains.

THE city of Berlin is chiefly built upon rocky strata composed almost entirely of the siliceous skeletons of lowly microscopic plants known as diatoms. The living representatives of these creatures are so minute that 10,000 of them could be ranged side by side on the length of an inch, and the weight of each is scarcely equal to the 0·0154 part of a grain.

UNTIL recently the residue remaining after refining tar with sulphuric acid has been regarded as worthless, but is now worked up into a black and somewhat elastic substance resembling asphalte. When dissolved in naphtha this forms a very durable waterproof varnish. After prolonged exposure to high heat the new rubber is reduced in volume about sixty per cent., becomes hard like ebonite and very elastic, and under different names is applied to various uses. It is a good non-conductor, and is therefore available for insulating.

A BEAUTIFUL collection in the museum at Cassel, Prussia, is that of 500 different European trees, arranged in the form of a library. Each specimen is in the shape of a book. The back is formed of the bark of the tree; the sides, of the perfect wood; the top, of the young wood, with narrow rings; the bottom, of old wood, with rings wider apart. The volume is a little box, containing the flowers, seed, fruit and leaves of the tree, either dried or imitated in wax.

A WELL-KNOWN chemical fact is, that although commercial metals are soluble in acids, pure metals are not. Dr. Weeren explains this curious anomaly by pointing out that the pure metals, when dipped in the acid become quickly surrounded with a protecting film of hydrogen. There is a slight action on immersion, but it ceases after a few seconds. When the escape of the hydrogen is aided by performing the experiments in a vacuum, or the hydrogen is caused to combine with oxygen, the metals, are attacked.

A NEW antiseptic agent called microcidine, which is composed of 75 per cent of naphtholate of sodium and 25 per cent of naphthol and phenyl compounds, has been tried in France. It is a white powder, soluble in three parts of water. The solution, which is cheap, is said to be a very effective antiseptic, without being poisonous or caustic or injurious to instruments or linen. Its antisetpic properties are inferior to those of corrosive sublimate or napthol, but surpass those of carbolic and boracic acids ten and twenty times respectively. The solution has given excellent results in dressing wounds.

PROBABLY very few people in Europe know anything about the taste of worms or slugs, although certain American, Indian, and African tribes are reputed to enjoy such delicacies. A correspondent "Buckland Junior" in the *People* details an accidental experience in this way, some worms intended for bait having found lodgment in some beef sandwiches. He describes the taste as by no means disagreeable, and furthermore, adds that he did not suffer from nausea on discovering what he had been eating.

A GERMAN botanist, Herr Regel, has made public the result of his researches as to the causes of the perfumes of plants and the factors which diminish or increase them. Light and heat naturally play a very important role. Darkness prevented the development of perfumes in flowers of which the buds were only slightly advanced when submitted to its influence, and even the plants whose flowers exhaled perfume only at night, lost their odour if compelled to live in continued darkness.

MESMERISM.

Mesmerism alias hypnotism was a few years since denounced by the scientific world in unmeasured terms. No expressions of scornful contempt were strong enough to characterise those fearlesss torch-bearers of advance thought, who, after patient'y, earnestly and exhaustively investigating the alleged powers of Mesmer, proved beyond the possibility of a doubt the genuineness of the mesmeric or hypnotic influence.

They were charlatans, imposters or mentally unsound in the eyes, not only of the medical profession, but the scientific world, with some few notable exceptions. The more charitably disposed among the great conservative societies of scientific thinkers were content to regard those who believed in such "absurdities" as mesmerism as "unduly credulous;" liable to be "duped;" and, therefore, not "safe" or "critical" investigators."

Camille Flammarion, the illustrious French astronomer, in his remarkable novel "Uranie," tells us that fifteen years ago he communicated to several physicians the magnetic phenomena observed by himself in the course of many experiments. One and all denied most positively and absolutely the possibility of the facts related, but on meeting one of these same physicians at the Institute in Paris, recently, he called his attention to his denial of the phenomena. "Oh!" replied the physician, not without shrewdness, "then it was magnetism, now it is hypnotism, and it is we who study it; that is a very different thing." The astronomer wisely adds by way of impressing the moral: "Let us deny nothing positively; let us study; let us examine; the explanation will come later."

A true scientist will take cognisance of the smallest fact, and though the light that floats before may appear a mere will-o'-the wisp, he will follow it until he demonstrates by careful, impartial, and exhaustive investigation whether it rest on the bed-rock of truth or not, remembering that the prejudices of hoary thought and early training may blind him to sensible appreciation of the true significance of the problem that confronts him. It is not more than five years since a paper read on "Hypnotism" in the medical society of a leading city was excluded from the report of the society's meeting, on the ground that the subject was unscientific and absurd,

From present indications we are entering a new field of scientific discovery, or to be more explicit, the great body of scientific thinkers are expressing a willingness to recognise phenomena other than material, and to treat with a measure of respect the views and discoveries made by the patient heralds of psychic truths which have long been tabooed as little worthy the attention of the materialistic scientific investigators, whose eyes have been accustomed to rest on the earth, its rocks, plants and animals, as the myths of bygone days. The age of electrical invention has been so marvelous that men have ceased to wonder at the inventive ingenuity of man. The age of psychological discovery upon which we are now entering, if it be unrestricted and receive the careful and unbiased attention of our best brains, will we believe, unfold a world of truth, eclipsing in its starting character as well as in its great utility the greatest discoveries since the man-child science was born; truths which will give to life a deeper significance, a richer meaning, a nobler impulse, a grander ideal.

TO INVENTORS.—Anyone having a good Invention can, on applying to the Editor, "Science Siftings," obtain the advice and assistance of a well-known Patent Expert, free of charge.

DUST.

In a recent number of *Longman's Magazine*, a most interesting contribution appeared from the pen of Mr. J. G. McPherson, in which he complained that no significance is given to dust unless it appears in large and troublesome quantities. It requires the persistent annoyance of dust-clouds to excite any attention. Dust, however, demands to be noticed, even when not in that collected, irritating motion known in Scotland as *stour*. The dust-particles floating in the atmosphere or suspended in the water have a most important influence upon the imagination, as well as upon the comfort of man. Though so small that a microscope magnifying 1,600 diameters is required to discern them, they at times sorely tax the patience of the tidy housekeeper, and the skill of the anxious surgeon. An æsthetic eye is charmed with their gorgeous transformation effects; yet some are more real emissaries of evil than poet or painter ever conceived.

Until the famous discovery made by Mr. John Aitken, of Falkirk, a few years ago, no one could reasonably account for the existence of rain. It was said by physicists that cloud-particles were attracted by the law of gravitation under certain conditions of temperature and pressure. But this famous experimentalist and observer found out that without dust there could be no rain; there could be nothing but continuous dew. Our bodies and roads would be always wet. There would be no need for umbrellas, and the housekeeper's temper would be sorely tried with the dripping walls.

A very easy experiment will show that where there is no dust, there can be no fog. If common air be driven through a filter of cotton wool into an exhausted glass receiver, the vessel contains pure air without dust, the dust having been seized by the cotton wool. If a vessel containing common air be placed beside it, the eye is unable to detect any difference in the contents of the vessels, so very fine and invisible is the dust. If both vessels be connected with a boiler by means of pipes, and steam be passed into both, the observer will be astonished at the contrast presented. In the vessel containing common air, the steam will be seen, as soon as it enters, rising in a close white cloud; then a beautiful foggy mass will fill the vessel, so dense that it cannot be seen through. On the other hand, in the vessel containing the filtered dustless air, the steam is not seen at all; though the eye be strained, no particles of moisture are discernible; there is no cloudiness whatever. In the one case, where there was the ordinary air impregnated with invisible dust, fog at once appeared; whereas in the other case, the absence of the dust prevented the water-vapour from condensing into fog. Invisible dust, then, is required in the air for the production of fog, cloud, mist, snow, sleet, hail, haze, and rain, according to the temperature and pressure of the air.

The old theory of particles of water-vapour combining with each other to form a cloud-particle is now exploded. Dust is required as a free surface on which the vapour-particles will condense. The fine particles of dust in the air attract the vapour-particles, and form fog-particles. When there is an abundance of dust in the air and little water-vapour present, there is an over proportion of dust-particles; and the fog-particles are, in consequence, closely packed, but light in form and small in size, taking the more flimsy appearance of fog. But if the dust-particles are fewer in proportion to the number of molecules of water-vapour, each particle soon gets weighted, becomes visible, and falls in mist or rain.

This principle that every fog particle has embosomed in it an invisible dust-particle, led Mr. Aitken to one of the most startling discoveries of our day—the enumeration of the dust-

particles of the air. Thirty years ago M. Pasteur succeeded in counting the organic particles in the air: these are comparatively few, whereas the number of inorganic particles is legion. Dr. Koch, Dr. Percy Frankland, and others have devoted considerable attention to the enumeration of the micro-organisms in the air, and Mr. A. Wynter Blyth, the public analyst in London, has done good service in counting the micro-organisms in the different kinds of water in the vicinity. Marvellous as are the results, still the process was comparatively easy. By generating the colonies in a prepared gelatin, the number of microbes can be easily ascertained.

But to attempt to count the inorganic dust seemed almost equal in audacity to the scaling of the heavens. The numbering of the dust of the air, like the numbering of the hairs of the head, was considered as one of the prerogatives of the Deity. Yet Mr. Aitken has counted the "gay motes that people the sunbeams." Though he could not enlarge the particles by a nutritive process, as in the case of the organic particles, he has been able to enlarge them by transferring them into fog-particles, so as to be within the possibility of accurate enumeration. His plan is to dilute a definite small quantity of common air with a fixed large quantity of filtered, dustless air, and allow the mixture to be supersaturated by water-vapour: the few particles of dust seize the moisture, become visible in drops, fall on a divided plate, and are there counted by means of a magnifying-glass.

We now come to the most pleasant of the investigations in connection with dust. The very brilliant sunsets which began in the autumn of 1883, and continued during successive seasons with gradually decreasing grandeur, have arrested the attention of the physicist as well as of the general observer. What is the cause of the brilliant colouring in these remarkable sunsets? What is the source of the immense wealth of the various shades of red which have been so universally admired? Gazing on a gorgeous sunset, the whole western heavens glowing with roseate hues, the observer sees the colours melting away before his eyes and becoming transformed into different hues. The clouds are of different sizes and of all shapes. Some float virgin-like in silver folds, others voyage in golden groups; some are embroidered with burning crimson, others are like "islands all lovely in an emerald sea." And when the flood of rosy light, as it deepens into bright crimson, brings into bold relief the circlet of flaming mountain peaks, it is like a gorgeous transformation scene. Stranger still, when the sun sinks below the horizon, and a dull ashen gray has possessed the western heavens, what occasions the hectic flush on the eastern horizon? Gradually the clouds are tinged with light red from the eastern horizon all over the zenith; whence comes the colouring?

It is a strange coincidence that these remarkably fine sunsets have been since the tremendous eruptions at Krakatoa, in the Straits of Sunda. Along with the lava eruption there was ejected an enormous quantity of fine dust. The decks of vessels, hundreds of miles away, were covered with it. Mr. Verbreek computed that no less than 70,000 cubic yards of dust actually fell round the volcano. This will give an idea of the enormous quantity of dust still floating in the atmosphere, and drifting all over the world. In the upper atmosphere, too, there must always be dust, for without the dust no clouds could be formed to shield us from the sun's scorching rays; and of cosmic dust there must be a considerable quantity in the air, produced by the waste from the millions of meteors that daily fall into it. Mr. Aitken has ably shown that the brilliancy and variety of the colourings are due to the suspended dust in the atmosphere.

All examinations of the volcanic dust lately collected from the atmosphere show that a great quantity of it is composed of small glassy crystals. An abundance of these would quite account for the peculiarity of the visibility of the first glow; and the evidence seems to indicate that the quantity of such crystals is sufficient to produce the result. When these are fully illuminated, they become in turn a source of illumination, and reflect their reddish light all around. In winter sunsets, the water-clad dust particles become frozen, and the peculiarly brilliant crimson is seen, colouring the dead beech leaves and red sandstone houses, and making them appear to be painted with vermillion.

If there were no fine dust particles in the upper strata of the atmosphere, the sunset effect would be paler; if there were no large particles in the lower strata, the beautiful sunset effects would cease. In fact, if our atmosphere were perfectly void of dust particles, the sun's light would simply pass through without being seen, and soon after the sun dipped below the horizon total darkness would ensue. The length of our twilight, therefore, depends on the amount of dust in one form or another in our atmosphere. Not only, then, would a dustless atmosphere have no clouds, but there would be no charming sunsets, and no thought-inspiring twilights.

It is now admitted that the inherent hue of water is blueness. Even distilled water has been proved to be almost exactly of the same tint as a solution of Prussian blue. This is corroborated by the fact that the purer the water is in nature the bluer is the hue. But though the selective absorption of the water determines its blueness, it is the dust particles suspended in it which determine its brilliancy. If the water of the Mediterranean be taken from different places and examined by means of a concentrated beam of light, it is seen to hold in suspension millions of dust particles of different kinds. To this fine dust it owes its beautiful, brilliant, and varied colouring. Where there are a few particles there is little light reflected, and the colour of the water is deep blue; but where there are many particles more light is reflected, and the colour is chalky blue-green. Along its shores the Mediterranean washes the rocks and rubs off the minute solid particles, which make the water beautifully brilliant.

Moisture is deposited on the dust-particles of the air which is not saturated, and condensation takes place while the air is comparatively dry, before the temperature is lowered to the dew-point. The clearest air, then, has some haze; and, as the humidity increases, the thickness of the air increases. In all haze, the temperature is above dew-point. And in all circumstances the haze can be accounted for by the condensing power of the dust-particles in the atmosphere at a higher temperature than that required for the formation of fogs, or mist, or rain.

But whence comes the dust? Meteoric waste and volcanic *debris* have already been mentioned. On or near the sea the air in impregnated by the fine brine-dust lashed by the waves and broken upon the rocks and vessel-sides. But the most active of all substances as a fog-producer in towns is burned sulphur. No less than three hundred and fifty tons of the products of the combustion of sulphur from the coal are thrown into the atmosphere of London every winter day. But the powerful deodorising and antiseptic properties of the sulphur assist in sanitation; and it is

better to bear the inconvenience of fogs than be subjected to the evils of a pestilence. At the same time it should be known that smoke particles can be deposited by the agency of electricity. If an electric discharge be passed through a jar containing smoke, the dust will be deposited so as to make the air clear. Lightning clears the air, restoring the devitalised oxygen and depositing the dust on the ground. Might it not, then be possible for strong enough electrical discharges from several large voltaic batteries to attack the smoke in the air of large cities, and especially the fumes from chemical works, so as to bring down the dust in the form of rain instead of leaving it in the form of mystifying fog?

Organic germs also float in the air. Some are being vomited into the air from the pestilental hot-beds of the lowest slums. In a filthy town no less than thirty millions of bacteria in a year will be deposited by the rain upon every square yard of surface. A man breathes thirty-six germs every minute in a close town, and double that in a close bedroom. The wonder is how people escape sickness, though most of these germs are not deadly. In a healthy man, however, the warm lung surfaces repel the colder dust particles of all kinds, and the moisture evaporating from the surface of the air-tubes helps the prevention of the dust clinging to the surface.

From this outline the reader will observe the increasing importance of careful attention to the influence of dust in the economy of nature. As a sickness-bearer and a death-bearer it must be attacked and rendered harmless; as a source of beauty unrivaled we must rejoice at its existence. The clouds that shelter us from the sun's scorching heat, the refreshing showers that clear the air and cheer the soil, the brilliancy of the deep-blue sea and lake, the charms of twilight, and above all the glory of the colours of sunrise and sunset, are all dependent upon the existence of millions of dust-particles which are within the power of mans' enumeration.

A SCIENTIFIC TOY.

Instantaneous photography has made great strides of recent years. Its practical applications, however, have not been very numerous, and we are pleased, therefore, to notice what ingenuity can do in applying it for entertainment purposes. The Blackfriars Photographic and Sensitising Co., of Surrey-row, Blackfriars, have submitted for our inspection a very ingenious application to an instrument taking the form of the zootrope, or "wheel of life." Although in our heading we describe the invention as a toy, it will, we venture to believe, prove interesting to children of mature growth. The instrument takes the form of an open circular tray with slits on the outer edge. In this tray is placed a band containing a series of instantaneous photographs of men and animals in motion, the regular progression of the parts constituting entire acts, such as running, jumping, etc. The tray is then rapidly revolved on a spindle stand, and the progression of the entire motion is rendered with lifelike fidelity. The photographs are by no less an expert than Prof. Anschütz, the well-known instantaneous photographer, so that the truth to nature is placed beyond all question. The apparatus, which is called the "Tachyscope," has already achieved great popularity, and promises to become a universal favourite.

The Coreans are the greatest eaters known. Their stomachs are generally abnormal in size, and the one possessing the largest is generally considered the richest.

MORAL SCIENCE AND MURDER.

There have been two processes steadily in progress of late years, first, the lengthening and complexity of trials, and secondly the elimination of the element or pain from punishment. The earliest stage of punishment was speedy torture; the latest is a mollified and merciful infliction of punishment after every conceivable means of escape is exhausted. A protracted murder trial certainly has features of a dangerous sort, and a sober study might lead us to believe that for society in general we have not gained as much as we supposed. Is there in reality so wide a difference between savages torturing a prisoner and a crowd of men and women viewing the variations of hope and despair evinced by a poor wretch in the dock. The element at the bottom is eye for eye, life for life. There is no change in that. We are yet working on the old barbarian principle, and need not cajole ourselves with the supposition that a modification of method is any change of the idea and spirit. But for the old speedy vindications we have substituted a long protracted discussion, imprisonment, trial by jury, and the agony of doubt and fear. There is nothing in speedy death, by any device, to be compared with the living terror that besets the waiting for trial of an ordinary victim. But we are creating exceptions to this. Fondness for sensationalism and public notoriety is increasing greatly the number of those to whom trial for a high crime and execution for the same is a subject or self-gratulation. It is the greatest event in their lives. Precisely the same spirit that induces others to endure, and seek to be involved in, the tortures of political prominence, smoothes the roughness of the lot of a vulgar murderer. He is in the papers, in the public eye, is noted. This is hardly all; we have already created, besides, a public sentiment of a maudlin sort, which is at once called out in the way of sympathy for a prisoner. The tendency to make a hero of a murderer is growing very pronounced. This is not the folly of a few undeveloped girls, but it is a wide-spreading and surely-spreading public feeling. There is an atavistic lapse in our civilisation going on, that makes heroes of brutes, that exalts brutal pluck. It is quite possible for us to go so far that the sentiment of justice shall be lost wholly; and we shall have also lost our moral abhorrence of the worst criminality.

The time has come when civilisation must consider the question whether the law of revenge is the true principle in punishment. Can it be so modified in its application as to rob it of the spirit of retaliation? Are we not certainly involving ourselves in deeper complications by softening and smoothing the road of the malefactor? Is that the true path of evolution? Have we not to strike at the root of the matter radically? We are already reversing totally the method and the principle of dealing with those imprisoned for long terms. Our prison system, it has been said, creates what it punishes. It increases the criminal sentiment. It intensifies the badness of its prisoners. It is quite possible to debauch the worse classes instead of elevating them. If imprisonment makes each prisoner worse, where have we a possible gain. Law has become as certain a method of shielding a rogue as of convicting him. A criminal court plays at a game that ends, in either case, in no advantage to society. If conviction takes place the scamp is put into a school to improve his knowledge of rascality, and after that is let loose; if acquitted, he plies again his trade. Our prison system has constituted a great educational course in vice and crime. Colleges for criminals! The tide is turning. Careful students of history and social reformers begin to get the ear of the virtuous community. The barbarian prin-

ciple of "eye for eye" must be given up. We have little interest in punishing; we have vast interest in reforming. To inflict shame or pain is the idea of the Iroquois squaws; it is also the idea of the common law; and it demands measures to suppress and destroy the criminal sentiment. There are but two methods, severity and speed, in inflicting pain; or the entire giving up of the principle of retaliation and the adoption of the principle of reformation. The instinct of retaliation is in us; it is the inheritance of our ancestry as savages. As late as King James 1. of Scotland men's legs were broken in the boot and their finger nails were torn out under the personal supervision of the King. You shrink with horror! What have you gained? You would faint at such a sight. Instead you prefer to inflict mental torture and moral contamination. Poor Jack Flinn, instead of having his nails pulled out, shall be shut up with foul rogues, to be finally turned loose seven times worse than he was. This is our reformed method. It is retaliation yet. It is the barbarian's principle softened so that we shall not turn ill in stomachs when we read the criminal reports.

Yet we find abroad a very morbid and very confused morality to this degree. It is resolved on the part of our legislators, and we think they reflect public sentiment, that it is no longer conformable to the advanced sentiment of our age, to make public exhibition of executions. But will someone explain how it is, that if the death penalty has for its special object to deter others from crime, it should not have the utmost possible publicity? Why should not the press publish the details with all possible picturesqueness? Why should not the public be invited to witness the horror en masse? In our secret unconscious convictions we are satisfied that this will do a vast deal of harm. We know that morbid natures are biased to crime by such scenes, and are not deterred. We feel the debasing effect of such exhibitions. Statistics show that where there is most publicity to punishment there is most crime. The only way to prevent a criminal class is to exaggerate the sacredness of human life. But so strong is the hold of the Mosaic law of retaliation that we try to satisfy our convictions by secluding the murderer and making his execution secret.

We have before us certain papers giving what notice is possible of the first American execution by electricity. The most modest of them speak of the matter in trivial terms. There is not a moral fibre touched anywhere. It is a pure case of brute force, and the result is a brute force influence. The discussion of the man Kemmler the first criminal to suffer death by electricity, was curiously anatomical, utterly unmanly and indecent. It is possible there may be wrought in time a slight change in the manner of referring to such criminals. Electricity is a reformer. But the suppression of an honest, full report is exactly what is not needed, if such judicial executions are needful. We do not find any pleasure in these softened newspaper reports. There is no twang in them. They are not profane, or shocking, or sacrilegious. What we read now is very tame. The etc. of apparatus and the select list of scientists present is not interesting. It is as if you should refuse to abolish bull-fighting, but should restrict the audience to professors of religion. Is science to quite edge the people to one side after this manner?

In reality the whole thing is barbarous, outlived and useless, only that we are too cowardly to abolish it. We shall go on for a while yet taking lives and trying to smooth over the horror, and then we shall cry out that there is no use in half-way work; and murder by law will follow murder contrary to law, and itself become a crime. What is the real wrong in murder? Let us see: It is taking a life. Well, we do that by hanging or its substitute. It is corrupting public sentiment. But we are so well satisfied that public hangings are demoralising that we have stopped that. We kill on the sly. What sneaking work it is. The State creeps off into a secret, unknown chamber, or a vault. It has its horrid apparatus, that is brought in on the sly. It breaks the man's neck between midnight and dawn, or otherwise it sends him into eternity. 'Tis a damnable job. Betwixt midnight and daylight, and only beasts of prey are abroad. The time will come, probably, when mothers will tell their children of these deeds as we tell of our ancestor's cannibalism.

It will be impossible for the State to assassinate a human being in the dark. It must do its deeds openly. There is no doubt but that we have taken one step backward in the tragedy of revenge. We meant well. A blunder has been committed. We must review our problem. Something better can be done with badly made men, badly born, badly educated, badly treated, badly endowed men than to kill them. For at the best we can thus eliminate but a few, and the rest are made no better. What we need is to reform, to save, to make better, to make over again. If we had no more prisons and no more gibbets, and instead had schools where every criminal was put through a rigid training, intellectually, morally and physically, and if then the results were an advance in morality, we might be proud and joyful in our civilisation. That, indeed, would be progress. No more bad men hanged, to be sure! No more sickening spectacles! No more morbid reports! No more scaffold piety! But instead a few more of the worst sort made better, and made useful; and some, also, not of the worst sort. There is in reality but one true aim of punishment—to improve. Revenge is no longer anywhere held to be a tolerable emotion. Science must do more for us than electrocution. There is a moral science as well as a science of dynamos.

MUSICAL GLASSES.

In the year 1746, the great composer Gluck introduced into London a new instrument, consisting of twenty-six ordinary glasses or tumblers, tuned to the different notes of the scale by pouring into them suitable quantities of water. These, touched by the finger, gave forth musical tones. It is not certain whether or not the instrument was known before this time, but immediately after its introduction by Gluck it became popular and continued so a long time, for fifteen years later—in 1761—Goldsmith's ladies, in his famous novel, allude to it as still in use. It attracted the attention of Dr. Franklin, who, in a letter written in 1762, described the instrument. Not content with it in the form in which it then existed, he soon began its improvement, made the glasses of a different shape, strung them on a spindle which revolved, dipping the lower ends of the basins in a trough of water. Franklin called his instrument the armonica, or harmonica, and since his time little improvement has been effected in it. There have been several great performers on the musical glasses. Miss Mariamne Davies, in the latter part of the last century, made quite a sensation in the various capitals of Europe by playing music especially composed for her by Hasse. In 1791 Marianna Kirchgassner visited Mozart at Vienna, and so greatly pleased and entertained him by her performances on the harmonica that he wrote for her an adagio and rondo. Among the varied compositions of Beethoven may also be found one or two little adagios for this singular instrument. The harmonica is still sometimes seen as a curiosity on the variety stage, and at present is generally played with a violin bow instead of the fingers, but no progress has been made towards tempering the piercing and unpleasant quality of its tones.

THE STRONG MAN.

Forty years ago or less the apostle of the hour was Carlyle, the fashionable gospel was the gospel of force, and the hope of the world was supposed to lie in the advent of certain heroes, strong, resolute men, who were to heal our social and other diseases by the prescriptions of a benevolent despotism. The gospel of force and all its accompanying ideas have somewhat fallen into discredit to-day. These latter times have proved very unfavourable to strong men, or at least to those who have tried to pose in that character. Louis Napoleon was a strong man: he greatly dared on a certain 2nd of December just forty years ago, and for a time he seemed to be a living justification of Carlylism; but the sage of Chelsea lived to see the Man of Destiny cast down from his high pre-eminence and every vestige of his rule obliterated by an indignant people. Bismark was a strong man, full of an almost reckless courage and utterly impatient to criticism and opposition; yet how sudden and complete was his fall! Thiers wished to play the part of the strong man in France, and so did Marshal McMahon after him; but the country put both of them aside and passed on to policies of which they disapproved. Later Boulanger pranced across the scene in the assumed character of a saviour of society; but as soon as the firm hand of lawful authority was laid on him he slunk into exile and dwindled into insignificance; finally, wrecked alike in character and estate, he sought, death at his own hand. Balmaceda was another would-be strong man, and he too fills a suicide's grave. Lastly, we have Parnell, a man whose courage was indomitable, whose fortitude could not be shaken, who by the sheer force of his personality baffled the plans and confused the policies of the ablest statemen of Great Britian; yet who, trusting to his strength to win him a personal triumph after he had violated the essential conditions of successful struggle, ended his career in failure and disgrace.

Evidently there is something wrong with the gospel of force. Heaven sends the strong men in fairly liberal supply, men who are quite prepared to fill the Carlylean requirements in the matter of doing and daring, despising small scruples and trampling on rights; but their success is short-lived, and their failure points a moral which is hardly to be found in the Carlylean philosophy. That moral is that, while strength is a good thing in itself, and courage and resolution are virtues, they need to be guided by knowledge, and a careful study of conditions, if they are not to rush on to disaster. Nay, more, we see that individual strength is only weakness unless it vibrates in unison with the greater strength of true principles of action, the strength that resides in the play of great social forces. No man to-day can win any great triumph except by being in the right, and this is the great political lesson which we should strive to impress on the rising generation. To be sure, there are many false lights—mostly, however, of a minor kind—shining in the world and alluring men to a career of selfish adventure. There are men who have climbed to business or political success by means that will not bear criticism. But the examples afforded by those who have tried such means to their own ruin are more striking and impressive, if not more numerous, than any that can be quoted on the other side.

Hero-worship is well if it simply means sincere admiration for noble qualities; but it is misleading in the highest degree if it causes us to trust for great results to the action of this or that masterful individuality. To-day the "common sense of most" is the most potent factor in all social and political progress, and no man is wise who does not bear this in mind. There is ample scope still for the exercise of the highest moral and intellectual qualities, and the true hero may yet win the admiration and gratitude of society; only, what is required is that he should know the structure and laws of the society in which he lives, and seek rather to give the best expression to the tendencies of the time than to impose his own individuality on his contemporaries. Only he who, in a profound sense, obeys possesses the secret of rule.

The times are favourable, we think, for the presentation of new political ideals. Strong men of the old type, iron-handed warriors, and stern legislators, are out of date; on the other hand, the want of firmness and principle in connection with political affairs was never more conspicuous. We want a new race of strong men in whom the gamester element shall be wholly absent, and who shall aim to accomplish their ends not by personal *tours de force*, nor yet by craft and flattery, but by steady adherence to principle, and patient efforts to awaken the public to a sense of their true interests. The strong man of the future will be strong in knowledge and in social sympathy; and his strength will be spent, not in efforts to perpetuate his personal ascendency, but in efforts to develop all that is best in the society of the time. The true strong man as we conceive him will have no greed for power; his greed, if such it may be called, will be for usefulness; and he will show his strength by his willingness to retire at any moment from a public to a private position, rather than prove unfaithful to his convictions or do anything unworthy of a man of honour. Strictly speaking, a man who with adequate knowledge and intelligence tries faithfully to serve the public can never be obscure, though offices should not seek him nor caucuses make mention of his name. The public at large will recognise and honour his efforts, and his influence may be greater in a private station than that of a score of average legislators. We do not, however, look to our educational institutions to do much to develop this new type of citizen; we trust rather to general educative influences that are abroad in the world. We trust, we may say, in a considerable degree to such writings as those of Mr. Spencer, instinct as they are with noble views of liberty and of justice, and conveying at the same time clear and enlightened ideas regarding the nature and functions of the state. It is possible that private associations for the purpose of causing more intelligent views of citizenship and its duties to prevail might accomplish very good work.

A NEW ANAESTHETIC.

A NEW method of producing local anaesthesia has been tried in Germany, with such complete success, that a boy watched, unmoved, while a deep incision, several inches long, was made in his thigh. The part to be operated upon is rendered insensible by cold, but, instead of receiving a direct application of the cold-producing agent, is touched by a metallic chamber or tube, which is cooled by the evaporation of carbonic acid. The temperature may be regulated, by simply turning a tap, from that of cold water to one so low as to cauterise. A slight burning is experienced when the tube is first applied, and this is quickly followed by anaesthesia, which lasts from one to two minutes, and leaves no ill effects. The cold may be used for cauterising, and offers the advantage of producing anaesthesia at the same time.

DR. COLLIN has brought out a novelty which consists of applying a rubber heel to walking boots, by which means the force expended in planting the foot on the ground is utilised to assist in progression of the wearer. According to this doctor's theory, the harder a man brings his heel down upon the pavement the easier will he walk.

PHRENOLOGY EXPLAINED.

By Stackpool E. O'Dell,
Author of "Phrenology: its Truthfulness and Usefulness," "Old St. Margaret's," "Merciful or Merciless?" "Brompton Lectures," "Mental Troubles," etc.
[RIGHTS RESERVED].

VIII.

The organ of Eventuality is situated above that of inviduality and is very easily perceived, in young children especially, where it oftentimes swells out in the form of a dome. This is a very important organ, as we consider it to be the storehouse of events, historical, local, personal, past or passing. In accordance with its size and activity it gives a desire, as well as ability to see and remember anything that may be set down as of an eventual nature. In accordance with other organs and mental training these events will be of a wide or circumscribed nature. Some people's minds will not go much beyond personal, household, or local events, while others again will take a great pleasure in studying the events of one or two centuries or ages, while a few want to know the events of all ages, they are insatiable, and nothing short of antedeluvian or prehistoric times will satisfy this craving. This organ is required to give a good general all-round memory, which adds much to the individual capability and general success in most departments of life. An individual with this organ large, even though he may deficient in many others, may manifest a more than ordinary amount of intelligence in either conversation or writing; the literary man especially requires it, more particularly those that are connected with journalistic literature, in either recording or describing events. The individual who has this faculty small will almost appear to be weak-minded, for he can neither relate nor enlarge upon anything in the way of events that he may have seen, read, or heard of, although he may, if other faculties are fairly developed, take an active and intelligent part in a conversation in the way of criticising and elaborating the events spoken of by others. Minds capable of originating are not so much at a loss on account of this deficiency, for it makes them all the more original; whether in speaking or writing, not being able to recall events either that they have read, seen, or heard, they are necessitated to develop their own orginating powers. It is possible for a man to be a most acceptable writer or speaker in some departments of literature and oratory, and yet have this organ deficient. We should like here to state both in connection with this and the other organs of the mind, that we believe each possesses a memory of its own. This statement would mean that there is not only one memory, but many memories, although one memory may assist the other. On this hypothesis only can we account for different states of mental retentiveness. We will generally find that the chief memory of the musician is connected with tune or harmony, that the chief memory of the mathematician is for figures, that the chief memory of the poet is connected with the beautiful and ideal, that the chief memory of the affectionate parent is connected with her organ of philoprogenitiveness, and so with each of the organs. The students of mental science should analyse this statement and see how it corresponds with their observations, indeed most individuals can think this matter out for themselves by observing the connection between certain formations of heads and the special memories of the individuals concerned; for let us remember we all have a special memory, specially active in some one or two departments. As this faculty of Eventuality is of such great importance to our success in life, it should be well looked after in regard to children and young people, when the foundations of a good memory can be laid so as to develop it in after life into great usefulness; for it is not everyone who can fall back on the originating power, and the average mind can originate all the better by having the material of the past or passing events to originate from. The only lasting and scientific method we know of for cultivating this or any organ, is to bring that portion of the brain connected with the faculty into a state of activity, just as you bring the digestive faculties into a state of activity in order to increase their ability to assimilate food. You have to go direct to the organ, whether it be that of eventuality, calculation, or tune, and cultivate that one organ. Thus you bring that portion of your brain into activity and strengthen it, and when it becomes strong it will have the required ability to work, and will take a pleasure in it. The question is oftentimes asked,—how long will it take to cultivate a weak organ, so as to bring it up to, or above the average amount of strength? The time required will much depend upon the capacity of the individual to concentrate attention, but speaking in general, one month's proper training ought to bring any organ into a state of perceptible growth and increased strength..

THF VIPER'S POISON.

Professor Kaufmann has made a thorough study of the venom of the viper, and has produced a most interesting work on the subject. The poison of the viper is a transparent acid liquid, colourless or slightly yellow, owing its poisonous properties, not to microbes, but to soluble matter. The micro-organisms which have been discovered in the poison are not constant, and when they are absent the venom maintains its normal activity; the isolated microbes, cultivated and inoculated into animals, are in no way pathogenic. Upon contact with the air, the liquid venom changes and loses its properties, nevertheless, it can be kept for some time and shows activity after several months careful preservation. After intra-veinous injection, the effects appear with terrible rapidity. At the moment of injection, the animals are greatly excited, they struggle and cry, but the excitement lasts for a few seconds only, they fall almost immediately into a profound stupor, which lasts up to death. There is, moreover, immediately after injection, an enormous decrease in arterial pressure, and an immense increase in the heart's action, but with a slight pulse. Animals, before succumbing to the poison, often show symptoms of hæmaturia, vomiting, and sanguinary alvine evacuation. It would appear that successive inoculations of small doses of the poison should give animals a certain immunity from the danger of large doses. The poison of the viper has no effect upon its own species.

Having turned his attention to substances capable of destroying the activity of the poison, M. Kaufmann found that permanganate of potash and chromic acid in the proportion of 1 : 100, proved the best antidote. In injecting a few drops into the point of inoculation and its neighbourhood, the development of local effects is prevented, and general effects are considerably weakened. These injections must be made immediately after being bitten; they may, however, prove still useful when the local accidents have had time to take a certain development before the application of the remedy. In the latter case, however, scarification must be practised, and a few drops of the solution of the permanganate and chromic acid injected into several points.

FREAKS OF NATURE.

A Good story is told of Buckland, the naturalist, who, on one of his visits to the Zoo, was attacked by a horned boar, and had to save himself by a headlong retreat.

"That brute would have knocked you down if he had struck you with his horns," remarked a sympathising friend.

"Oh, I don't care," said the philosopher; "But it worries me to notice that he never does use his horns, as you call them. They are horn-shaped tusks and curved too much backward to be of any service in fighting. What in the world can be their practical purpose?"

Naturalists of that sort are liable to a good deal of worry. Nature abounds with unexplained phenomena. Of what use, for instance, is the long tail of the male pheasant to a bird that has often to save itself by flight? In some varieties (as in the Chincse silver pheasant), the problematic appendage is nearly 6 feet long and makes it almost impossible for its proprietor to take wing at short notice. In running through the tangled underbrush of a tropical forest the tail is hardly less obstructive, and is certainly not ornamental enough to compensate its undesirable tendencies. And again, of what benefit to its owner are the enormous horns of the Wapiti stag-antlers with a spread of 56 inches and a weight of 25 pounds? Besides stretching left and right almost as far as a man of average size could extend his arms, they send out a number of lateral branches, forming a system of hooks and prongs exquisitely adapted to catch against every bush, as the encumbered animal dashes along through the maze of its native woods.

"I would not care for the bite of a mosquito if it wasn't for its infernal whine," we have heard many people say, and it seems, indeed , not quite easy to understand of what profit the droning and buzzing sound of its wings can be to any blood-sucking insect. It merely serves to warn or annoy its intended victims to whom it can hardly be more aggravating than to the whining little vampire itself.

A still greater enigma is the deadly virus of the African tsetse fly. In Southern Nubia, there are districts where herdsmen have to drive their cattle hundreds of miles every spring to avoid the bite of the little pest, whose private purpose is limited to the extraction of a few drops of blood, and whose interests have no imaginable connection with the subsequent agony of its victims. A day or two after a stout steer has been bitten strange swellings appear under his jaw and about the groins; the animal shivers and twitches as if in extreme distress, and finally dies in convulsions, often attended with outbreaks of fury similar to those observed in an advanced stage of hydrophobia. The testimony of such travellers as Dr. Livingstone and Sir Samuel Baker leaves no doubt about the actuality of the described results; yet if a wasp should be provided with an apparatus to poison every pear it nibbles the arrangement could hardly appear more preposterous. The gratuitous destructiveness of certain carnivorous animals presents a very similar problem. An otter in a well-stocked fish-pond will kill about fifty fishes for one it eats, and the murderous instinct of the weasel and the European pine marten far exceeds the needs and conceivable interests of the little demons. An amateur poultry fancier once lost twenty-eight chickens in a single night, all of them having been killed by a small sharp bite into the base of the brain. In three or four cases the murderer had gnawed the skull of its prey and torn open the neck in quest of blood, but with those exceptions the massacres seemed to have been prompted by a sheer wanton love of havoc. With a little more prudence, the poultry-loving marten could have repeated his visits and banquets for a long series of nights and have all his depredations credited to one or the other of the half hundred different disorders fowls are heir to, for the hen house haboured an army of feathered bipeds, some of them on the sick list. But that one night's mischief ended the game. The fiend was tracked to his hole and trapped the very next evening.

As a rule defenceless animals are dressed in the colours best adapted to conceal them from their enemies, and kind nature goes so far as to vary the protective hue of certain creatures with the different seasons of the year, as in the case of the Norwegian grouse, whose plumage is brown in summer, but turns white at the approach of winter.

But the close study of that rule reveals some curious exceptions. In the Arctic regions, where snow-white would be the best possible protective colour, several species of seal are dressed in suits of black and dark brown that contrast strikingly with the bleak surface of the icefields, and attracts polars bears and other connoisseurs of sealskin from a distance of many miles. Sparrow-hawks often pursue summer redbirds, that try their best to escape by darting into a thicket of tangle vines, but are betrayed again and again by a colour that "flames as if it was going to set the woods afire," as Henry Thoreau expresses it. Several species of tropical finches are attired in even more risky hues—a glaring combination of white and scarlet or of yellow and dark-blue; colours that can not possibly escape the attention of even a casual observer. Butterflies fight the struggle for existence under similar disadvantages, and many species of their helpless caterpillars seem to have been coloured expressly for the convenience of their chief enemies, the predatory ichneumon wasps, who can hardly fail to see a coil of red and dark brown worms in a green tree.

TRAVELLING BY PNEUMATIC TUBE.

A contemporary, usually credited with extreme sobriety, publishes the information that a company is being formed, in Hamburg, for the purpose of providing for travellers what is already done with messages, which, as most of our readers are aware, are already being transmitted by the Post Office to some quarters, by means of pneumatic tubes. A line of 15 miles will first be constructed between Hamburg and Buchen, and the distance will, it is said, be accomplished in eleven minutes, which is equal to a speed of about 68 miles per hour, and a greater speed still, it is claimed will be reached. The tube which holds the passengers, will be about 3ft. 3in. high, and 6ft. 7in. long ; only three passengers being carried together. The confined space in which the passengers are packed will receive a supply of fresh air from a special reservoir. The cylindrical iron tubes will be constructed by the Mannesman process, and the maximum of speed will be reached in thirty seconds. It is expected that the motion will be of the easiest, in spite of the terrific speed, and the interior of the vehicle will be lighted by a small incandescent lamp. When once the tube is started, the passenger will be quite unconscious of the speed, or in fact, any motion at all, except when on the point of stopping. The passenger will be allowed a small quantity of luggage, but smoking will be strictly prohibited. Our contemporary, in commenting upon this invention, gives as its belief that in the struggle for speed, a velocity of 200 miles an hour will be easily accomplished towards the end of the present century.

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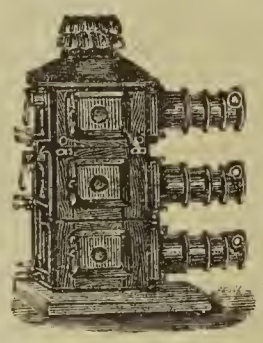

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SCIENCE NEWS AND NOTES.

"To me there never has been a higher source of earthly honour or distinction than that connected with advances in science."—SIR HUMPHREY DAVY.

Britain's National Crime

is the way our treatment of the opium question is designated by the anti-opium organs. The Calcutta *Medical Record* says :—"Dreadful as are the evils of alcohol, the pernicious consequences of indulgence in opium are more vastly terrible. By it human life is shorn of every vestige of nobility and moral responsibility. The mind is rendered insensate to every ennobling desire or sentiment, and the moral nature of man is unfathomably degraded to even greater depths than brutishness. Digestion becomes steadily and speedily impaired, and the whole physical sequellæ are those of emaciation, attenuation, and devitalisation of muscle, nerve, and brain. Opium numbers its victims by thousands in Calcutta alone, and every city throughout the length and breadth of this vast empire of India and Burmah yields a condemning freight of evidence of physical suffering, moral degradation, and social ruin, which none but a callous Government steeped in the luxuries of an irresponsible bureaucracy would dare to despise. Yet this awful stigma attaches to the Government of India, that it not only freely permits the sale of a pernicious drug, but protects and encourages the continuance and permanency of its ravages among a people whom it has been called upon to regenerate and save." We have been shown a portrait of a slave to the opium habit, which was taken by the Rev. Arthur W. Prautch, of Bombay. The poor wretch, the subject of the picture, is extremely attenuated, the eyes have a glassy stony stare, and the viens stand out in relief on the forehead. Of course, all these symptoms may not be the result of indulgence in opium, but if they are, it is certainly an active argument for legislation in this direction. If the production of the opium cannot be abolished, its sale can certainly be restricted without the revenue suffering any immediate evil effects.

Milk Drinkers

frequently complain that they cannot consume this fluid without being "distressed by it." The importance of milk in the dietary of invalids cannot be exaggerated, and, therefore, the hint given by a medical man as to the proper way to consume it, is most welcome. The most common reason why milk is not well borne is due to the fact that people drink it too quickly. If a glass of it is swallowed hastily, it enters the stomach and then forms in one solid, curdled mass, difficult of digestion. If, on the other hand, the same quantity is sipped, and three minutes at least are occupied in drinking it, then on reaching the stomach it is so divided that when coagulated, as it must be by the gastric juice, while digestion is going on, instead of being in one hard, condensed mass upon the outside of which only the digestive fluids can act, it is more in the form of a sponge, and in and out of the entire bulk the gastric juice can play freely and perform its functions.

An Ancient Relic

has been discovered in Galveston, U.S.A., which forms food for much speculation. It is a silver shekel of the time of Simon Maccabens, who lived 142 years before the beginning of the Christian era, and consequently is 2,033 years old. The coin is estimated by competent judges to be worth for its numismatic value £1,200, while the intrinsic value of the silver it contains does not exceed a couple of shillings.

Telegraphing Pictures

has made some important advances of late years. We have seen the results of some of the experiments recently tried and they are certainly interesting, although far from perfect. It cannot be claimed, however, that there is anything novel about the invention, for there are many patents dealing with it of considerable age. We look forward to the day when it will be possible to include our portrait in a sixpenny—perhaps a penny—telegram.

The Probabilities of Life

have been dealt with in some recent statistics published in Germany. They form a very interesting study. The average duration of life, according to these figures, is thirty-seven years, but those who are approaching that age need feel no anxiety, for they should remember that they have

passed the real danger period, which is during minority. Over a quarter of each generation die before attaining the age of seventeen. Of 1,000 people born, only six will be likely to pass the age of sixty-five. If you want to increase your chances of life, marry, for, as a rule, married men live longer than bachelors. The latter, however, claim some compensating advantages. More women reach the age of fifty than men, but after that period the stronger sex has the best of it. Tall persons live longer than short, and those born in the spring have sounder constitutions than those born at any other season.

Dr. Elkin,

the astronomer of Yale University, U.S.A., and formerly of the Cape of Good Hope, has, by a long series of observations on the parallax of the star Arcturus, arrived at the conclusion that it moves with the inconceivable velocity of 381 miles a second, that is to say, it would traverse the distance from London to Edinburgh between two ticks of a watch. This is twenty-one times faster than the speed of the earth in its orbit round the sun. Dr. Elkin also finds that Arcturus is so far away from us that his light, travelling 190,000 miles a second, takes 181 years to reach us.

An Interesting Exhibit

at the World's Fair in Chicago will take the form of a segment of a globe, a counterfeit presentment of that portion of the earth which is covered by the United States and Alaska. It will be a huge slice cut off from the terrestrial sphere, as one might take a piece of an apple off with a knife. The intention is that it shall occupy the middle part of the floor space devoted to the display of the scientific bureau, rising out of the floor like a round hill 25 feet across. Visitors who walk about it will be astonished to see what a great curve of the world's crust lies between New York and San Francisco, so that a straight line joining the two cities would be hundreds of miles underground at Omaha.

The Curvature of the Earth's Surface

will be most excellently shown by this means, and those who have always pictured the United States as flat, will be somewhat astonished at this correct representation of a part of their country. The exterior of the globe segment will be a complete relief map, showing all the important geographical features of this part of the world. It will be painted—the seas, lakes, and rivers in blue, and the land in other tints. Everything will be reproduced exactly on the scale to nature, and the observer will be surprised to discover how smooth and round this planet is after all, even the Rockies and other lofty ranges of mountains seeming hardly more than trifling roughness on this scale. The latter will be one foot to every million feet. Other great maps in relief will represent the bottoms of the oceans as they would look if all the water in them were taken away. People will thus have an opportunity to see how the eastern edge of the Continent of America is really far out in the Atlantic, where it falls suddenly to the vast plain of the seas—the depths where monstrous carnivorous fishes, blind or with enormous eyes, live by devouring one another in the entire absence of vegetable life. In imagination they can dive into wonderful holes, six miles and more in depth, which one comes across with a sounding line on the way around from Newfoundland to Alaska, by way of the West Indies and the Caribbean Sea. Two of the most remarkable of these chasms are found in the latter place and just north of Cuba, affording suitable retreats for whole tribes of mighty sea serpents and other mysterious horrors on which the imagination of man is somewhat prone to dwell.

A Bullet in the Brain

is usually fatal to human life, but a most interesting case, showing the tolerance of the brain to the presence of foreign bodies, is reported from America. The patient was a boy who had received a bullet on the left side of the forehead just above the orbit. He was supposed by his parents to be dead. Dr. Cronyn, however, in probing the wound, came in contact with the bullet; a "click" was heard, and the bullet moved backward. There was then twitching of the limbs, respiration, and other signs of returning animation. Three days later the patient became conscious, but he was unaware of what had happened. The right arm and leg were at first paralysed, but gradually improved, and within three months he was able to be up. Before the accident he had been able to read and write and also to count, but after the accident he lost all recollection of even the alphabet. His capacity for calculation, however, had improved very much. In due time there was complete restoration to an ordinary condition, and the spot where the bullet had entered could scarcely be recognised, so that at a medical society at which he was shown doubt was expressed as to his having ever sustained a gunshot wound of the head. Nine years and a half after the first accident, however, the boy was struck on the other side of the head, and died in a few days. At the necropsy the bullet was found saccnlated in the posterior portion of the left hemisphere, lower in the brain than the point of entrance.

The Artificial Manufacture of Eggs,

which we reported in a recent issue, has attracted much attention, and we now hear that another patent has been taken out for a similar method by Mr. James Storrey, of Kansas City. Mr. Storrey's ingredients are lime water, bullocks' blood, milk, tallow, peas, and a few other things, including some secret chemical preparations. The machinery for putting the egg together is very ingenious. First, the yolk is run into a mould to be properly shaped, and is then dumped into second mould which contains the right proportion of the preparation which stands for the white. This, being a gelatinous substance, encases the yolk very readily. Then, by means of a special machine, the whole is covered with a shell made of lime water and glue, which hardens after it is set. Mr. Storrey guarantees his eggs to keep "new laid" for a month, and he says that he can turn them out at a cost which will allow of them being retailed at the rate of three cents. per dozen. This is far cheaper than the process to which we recently referred.

The History of Chloroform

formed the subject of a recent note, and a correspondent, "J. E. B.", nows draws our attention to the fact that the merit of having first applied the singular properties of this substance to the alleviation of human suffering belongs to the late Professor Sir J. Y. Simpson, of Edinburgh. It was first applied as an anæsthetic at Edinburgh on the 15th November, 1847. Chloroform was independently discovered in 1831 by Soubeiran, as well as by the American chemist, Guthrie.

An Electric Fog Eater

is suggested by Mr. W. N. Jennings, who claims to have been the original photographer of lightning flashes. He says: "At midnight I noticed flashes of lightning illuminating my bedroom. A camera was loaded and an excursion

into the country taken, hoping to obtain a few new photographs of Jove's handiwork. The night was very foggy, and the flashes of light, very frequent and vivid, gave only blurred images of trees in the foreground. At 1.30 a.m., as I was about despairing of obtaining photographs, a sudden streak of lightning shot right through the fog, followed by a heavy peal of thunder, and in less than thirty seconds the fog had entirely disappeared, being precipitated by the electricity in the atmosphere. In these rain-producing days perhaps some inventive genius will take a hint from this occurrence for the dissipation of a fog on a large scale by introducing large power-driven Holtz machines on ship board and sending a stream of electricity into the fog-laden air from various points along the rigging, thus producing a clear area in the neighbourhood of the vessel. And who knows, perhaps, by an extension of the system, some day we may see a fog-less London."

The Microscope

has revealed to us many interesting things, and Mr. J. A. Tweedale writes to us suggesting an examination of the deposit on the teeth. He tells us that when this is placed under the microscope it will be seen to consist of millions of minute creatures. These appear to consist mainly of two species, a third appearing in the mouths of very inveterate smokers. The growth of all these is, when compared with that of other animalculæ, exceedingly slow, and light rapidly kills them. The most numerous species is in appearance rather like a tiny thread. These grow thicker and thicker, and when they reach a certain thickness split into two separate creatures. The second in point of number are something like a pea with a small cone at the top. Soon after their birth these shoot out a kind of tail from the end opposite to the cone; this after growing for a while, forms another round body. The creature then splits in the middle, leaving two distinct animalculæ. The third consists of a number of round bodies joined by a thin membrane. These every now and again split off to perpetuate their species, and so proceed *ad infinitum*.

An Interesting Experiment,

which bears out all that has been proved of the importance of light to plant life, was lately made, as the result of an accident, by the Botanical Missions despatched some months since by the authorities of Kew to the West Indies. They had with them a number of Wardian cases containing vine cuttings and Gambier plants, which it was deemed very desirable to introduce into this island; but, unfortunately, cold weather set in, and the efforts to convey these tender plants, which had so often ended in failure, threatening once more to result in disappointment. The difficulty was that if kept on deck they would be inevitably destroyed by the low temperature; while, if taken below, the absence of light, which is so necessary to the existence of the delicate Gambier plants, was almost certain to be equally fatal. Under these circumstances it occurred to Mr. Morris to avail himself of the electric light, of which there was an abundance aboard the "Atrato." The experiment proved in every way successful. Mr. Morris expresses the opinion that the use of the electric light for the safe passage of valuable plants during the winter months is capable of being greatly extended.

The Use of a Current of Electricity

as a promoter of growth in plants has been effectually demonstrated in France, as we lately reported, but other details of these experiments that have come to hand are even more interesting than those already described. It appears that a row of hemp subjected to the influence of the current produced stalks 43 in. higher than those not electrified. A kilogramme of potatoes yielded 21 kilos of very large and healthy tubers, while the unelectrified plants gave only 12½ kilos of medium-sized roots. Electrified tomatoes ripened eight days sooner than those which were unelectrified. These experiments support those conducted some time ago upon radishes, which were stated to have attained prodigious dimensions under the influence of a feeble current. The method adopted is stated to be simply burying a zinc plate at one end of the seed bed and a copper one at the other, the two being connected with a copper wire.

In a Total Eclipse

of the sun the point of the shadow cone, which is constantly projected into space by the moon, touches a narrow strip of the earth's surface, from which region alone the sun is totally obscured. These total eclipses, Prof. Schubert tell us occur about three times in four years, but a total eclipse for any given region does not occur oftener than once in 200 years. It is, therefore, possible when an eclipse of the sun is described in connection with some remote historical event, and the hour is mentioned, to fix the he period of the occurrence exactly.

Historical Research

is thus aided, and to facilitate reference Prof. Von Oppolzer, Viennese Astronomer Royal, has with the aid of ten assistants, fixed the date of 8,000 eclipses of the sun and 5,200 eclipses of the moon, extending over a period from 1200 B.C. to 1163 A.D., the calculations filling 242 thick folio volumes. Two applications of these data may be cited. The oldest recorded eclipse, which occurred in China 4,000 years ago, is mentioned in the Chinese book "Schuking" as taking place in the early morning, in the last month of harvest, in the fifth year of Emperor Tsehung-hang's reign. Other facts show that this reign was undoubtedly in the twenty-second century B.C., and the only eclipse that would apply took place on October 22, 2137 B.C.

It is recorded Christ suffered

in the nineteenth year of Tiberius, in which year the sun was darkened, Bithynia shaken, and much of Nicea laid in ruins. One writer mentions that a total eclipse of the sun, lasting from the sixth to ninth hour occured in the reign of Tiberius during full moon, and another adds that it occurred on the 14th day of the month. Now, an eclipse of the sun at full moon is impossible. Reference to Oppolzer's work shows that the only total eclipse of the sun in that region, between eight years before our reckoning and 59 A.D., took place Thursday, November 24, 29 A.D. This is not reconcilable with the scriptural account, which places the crucifixion at the Jewish Easter. An eclipse of the moon, however, was visible at Jerusalem on April 3, 33 A.D., so that it is most probable that ancient historians confused the two events, and that the eclipse of the moon was the phenomenon which signalised the crucifixion.

The Steam Power of the World

is equal to the strength of 1,000 millions of men, or twice the number of working men that exists. The horse power of England as regards engines is estimated at 7,000,000; of the United States, 7,500,000; Germany, 4,500,000; France, 3,000,000; and Austria, 1,500,000. These figures do not include the horse power of locomotive engines, of which it is estimated that last year there were in the whole of the

world 105,000, representtng horse power from 5,500,000 to 7,000,000. From further calculation it is considered that the total horse power of the world's engines is about 49,000,000, the average strength of each engine being equal to three horses, the power of the horse being equivalent to the strength of seven men. The steam engine there is no question has been of the greatest possible advantage to the working classes all over the world, for it has lessened their labour by doing the heaviest portion of the work, and so saving their strength. Yet machinery for economising human labour even now is strongly opposed by those who would be most benefited by it.

The Activity of Bats,

and the wonderful fashion in which they twist and turn about, while occupying an infinitesimal space, must have aroused the curiosity of all inquiring minds. The most remarkable thing about their motion is that even when flying through the trees with such remarkable rapidity, they never come in contact with the branches or hurt themselves. Spallanzani, the Italian naturalist, placed a bat in a dark inclosure, across which were stretched a number of threads, crossing and recrossing each other. The bat flew rapidly back and forth, trying to effect its escape, but avoided the threads with as much ease as if they had not been in its way in the least. Whether this curious power was the result of a sixth and unknown sense was long a puzzle to naturalists. To decide this knotty point, Spallanzani resorted to the cruel expedient of blinding a bat, and found that it still flew among the threads without being, to all appearances, any more inconvenienced than if it still had its eyesight.

Mexico

has always conveyed an idea of riches to the Western mind. We associate it with the Incas, with their gorgeous palaces and jewels, and the rich mines of which in most instances only the barren workings remain. But even now the country appears to be rich in certain resources, although they are practically valueless owing to the lack of means for transportation. We learn, for instance, that the rails of the Mexican Gulf Railway are laid on sleepers of mahogany, and the bridges are built of white marble. On the west coast of Mexico there is another line which has sleepers of ebony and ballast of silver ore drawn from old mines beside the track. The reason for this apparent extravagance is that the engineers had no other materials on the route, and found it cheaper to use these than to import the ordinary plant.

Professor Elihu Thompson

is one of the best-known men in the electrical world, and his name forms part of the title of one of the greatest electrical concerns in the United States. His brain has worked out all the mechanical ideas that have made the company tremendously rich and famous in the last decade. This man of genius is only about 5 feet 4 inches high, or perhaps a little taller. His figure is even boyishly slight, and his face is very much younger in appearance. His brown moustache gives him an older look, but if it were not for that he would be startlingly youthful looking. As it is, he is a few years short of forty. He was always famed for his precocity, and he had to wait two years before he could enter the High School in Philadelphia, because he was so young. He was a professor of chemistry before he was twenty-three years old. When he was eleven years old he began experiments with Leyden jars, and continued experiments in electricity uninterruptedly until he was thirteen years of age. He lived in Philadelphia, and when he would try his prentice hand on his first dynamos he used to travel into the woods away from home to strip the elderberry bushes and get elder pith to make insulating material with. When he was short of this he would get from the neighbours the silver foil from tobacco and use that. He ought to be worth a large fortune to-day, but he is comparatively poor, and he devotes his energies to the supervision of the technical electrical works of the company exclusively. Prof. Houston, the man whose name is joined with his in the title of the company, is not directly connected with the concern, but is a plodding professor of physics in Philadelphia. A Thomson-Houston Tramway has recently been laid at Leeds.

Boiling Alive,

is still practised with lobsters, cruel as the custom is. Our forefathers—and indeed, our parents—let calves bleed slowly to death, on the theory that in no other way could white meat be secured, and later on calves were bled one day and killed the next. Now everyone knows that a calf can be killed in a humane manner and the veal made just as good. In America hogs are largely killed by electricity instead of by the old barbarous method ; and, generally speaking animals killed for food have been put out of the way in a much more humane manner than formerly. But lobsters are still tortured out of existence, the only difference being that, while formerly they were exclusively boiled to death, now some are boiled and some broiled. Which process causes the most agony no one can say.

The Valley of Death,

is situate in the Island of Java, and derives its name from the deadly fumes that arise there. The natives cannot account for the poisonous odours, nor has their presence been explained, This awful place is about 35 feet below the surrounding ground, looks like a dry bed of a stream, and is about one mile in circumference. An English officer who recently visited the place, noticed as he approached the valley a suffocating smell, and was attacked with dizziness and nausea. A belt of this fetid atmosphere surrounds the valley. He passed through it and in purer air was permitted to view an awful spectacle. The floor of the valley was covered with the skeletons of men, wild hogs, deer, birds and small animals. The entire bed of the valley is one solid rock and he could not descover a hole or crevice from whence the poisonous fumes came. Surrounding this desolate place are hills covered with luxuriant vegetation. After viewing the valley from a distance he became bolder and approached the edge of it. He had a desire to reach the bottom of the valley, if possible, but was afraid to make the attempt. Determined, however to know what the fumes smelled like he started to descend the bank. His pet terrier had accompanied him and as soon as he saw his master step over the side of the bank he dashed ahead of him. He endeavoured to call him back, but it was too late. The moment the little animal reached the rocky bed he fell over on his side. He breathed perhaps ten minutes. Tempted though he was to try and rescue his dog, he dared not do it. While there he saw a bird fall. It had evidently intended to fly to the bottom of the valley, but it was dead before it struck the rock. So many lives have been lost while attempting to explore the valley that the natives and others have determined to keep away from the spot for ever.

THE intensity of the sun's light is 801,072 times greater than that of the moon.

THE PRIZE SCIENCE SIFTING.

One Guinea will be paid each week to the contributor of the most interesting or curious Science paragraph.

The paragraph must not exceed 200 words, and need not be original, but in this case, the source from whence it is copied must be given. All paragraphs must reach us on Monday, and be marked "Prize Science Sifting" on the envelope, unless a postcard be used. Only one paragraph may be sent in by each competitor.

The Editor reserves the right of publishing any paragraphs sent in.

We have awarded the prize of One Guinea to Mr. ERNEST LESLIE SIKES, 13, Wolverton-gardens, Hammersmith, W., for the leading "Science Sifting." The other siftings published all deserve honourable mention.

Power of the Bee.

In a recent work on the bee, Mr. T. W. Cowan states that the insect can draw twenty times its own weight, can fly more than four miles an hour, and will seek food at a distance of four miles. By a beautiful mechanical adaption its wings bear it forward or backward, with upward, downward, or suddenly arrested course. Its threefold voice organs are the vibrating wings, the vibrating rings of the abdomen, and a true vocal apparatus in the breathing apparatus or spiracle. The buzz is produced by the first two, and the hum, which may be "surly, cheerful, or colloquial significant," by the vocal membrane. A number of the bees' notes have been interpreted. "Humm" is the cry of contentment, "wuh-nuh-nuh" glorifies the egg layings of the queen, "shn-u-u" is the note of the young bees at play, "s-s-s-s" means the muster of a swarm, "b-r-r-r" the slaughter or expulsion of the drones, and the "tu-tn-tu" of the newly-hatched young queen is answered by the "qua-qua-qua" of the queens still imprisoned in their cells.

Divisibility of Matter.

A remarkable instance of the divisibility of matter is seen in the dyeing of silk with cochineal, where a pound of silk, containing eight score threads to the ounce, each thread 72 yards long, and the whole reaching about 104 miles, when dyed scarlet does not receive above a drachm additional weight; so that a drachm of colouring matter of the cochineal is actually extended through more than a hundred miles in length; and yet this minute quantity is sufficient to give an intense colour to the silk with which it is combined.

Harry French, 15 *Broadway, Wimbledon, S.E.*

Protoplasm.

All forms of life, animal or vegetable, complex or simple, are essentially developments of protoplasm. This highly complex semi-fluid substance is the basis of every living organism, and gives rise to all the manifold constituents of a living animal or plant, by chemical action with the substances such as air and water with which it comes in contact. Every cell or unit in the structure of the living organism was once a mass of protoplasm: without protoplasm there can be no life, when the protoplasm disappears (as in the hard wood of a tree,) life and growth cease in that part. It is absurd in view of the extraordinary developments of the science of organic chemistry in recent years, to put the syntheses of protoplasm among the chemical problems of the future? Why should not this complex compound of some eight or ten elements be some day prepared in the laboratory, and modern science reach its culminating triumph in the creation of life; for life is but the sum of the properties of protoplasm.

H. C. Haycraft, 48, *Breakspears-road, Brockley, S.E.*

The Eyes of Animals.

Human beings have six muscles to each eye, by the help of which they can easily move it on either side, but horses and cattle are in possession of an extra one, requiring its use to support the eye-ball while inclining their heads in search of food. The cat and the tiger, which habitually prowl about in the dark, possess an extraordinary power in the way of expanding the pupil. Fish have no means of moistening their eyes, like other animals, as it would be obviously unnecessary; neither have they any eyelids, but their cornea is horny, and capable of defending the sight. The mole has two tiny small eyes hid under its velvet coat, being admirably suited to his mode of living underground. Spiders have four, six, and, not uncommonly, as many as eight eyes, beautifully bright and transparent, which lend them the remarkable power of seeing all round at once without the need of a single movement of their body. The lizard, known as the chameleon, has a most wonderful command over the muscles and movements of his eyes. Not only is he capable of casting a proper wink, but, while keeping both eyes open, he can hold one quite still and move the other about in all directions. He can fix one of them on the sky and the other on the ground, or while one looks forward the other turns round and glances behind at the same time.

V. Tudor, 37, *Ashmore-road, W.*

Man and his Relation to Blight.

Everyone has some idea of the destructiveness to plants of blight-insects, or Aphides, but few are aware that these little creatures reproduce themselves with such marvellous rapidity that, were it not for their natural enemies, Ichneumon-flies, lace-wing-flies and lady-birds which feed upon them, they would quickly overrun the earth, destroy all vegetation, and thus indirectly annihilate both man and beast. But this is an evident fact. Here is the proof;—Reamur, a noted French naturalist, computed that one Aphis during the few weeks of its life gave birth to no less than 5,904,900,000 young; and this reckoning carried to the last brood in the year is found to reach the enormous number of 68,122,318,582,951,682,301,000,000,000,000,000, a figure beyond all comprehension, but the significance of which Professor Huxley has tried to bring home in the following way. On the suppositions that 1,000 Aphides weigh a grain and a very stout man twenty stone, he states that it represents the weight of 34,061,159,291,475,841,150,500,000 stout men, or more than twenty-two thousand billion times the weight of the entire population of the globe. And this it must be remembered is only of the produce of an original Aphis.

Edward Thompson, 31 *Hugo-road Tufnell Park, N.*

Iron Paper.

It will not perhaps be remembered that, in the great Exhibition of 1851, a specimen of iron paper was exhibited. Immediately a lively competition ensued among ironmasters as to the thinness to which cold iron could be rolled. One ironmaker rolled sheets the average thickness of which was the $\frac{1}{1800}$th part of an inch. In other words 1800 sheets of this iron piled one upon the other would only measure an inch thick. The wonderful fineness of this work may be understood when it is remembered that 1200 sheets of the thinnest tissue paper measure a fraction over an inch. These wonderful iron sheets are marvelously smooth and easy to write upon, notwithstanding the fact that they are visibly porous when held up in a strong light.

T. Griffith, Manor House, Hale, near Liverpool.

GLEANINGS OF THE GLOBE.

Water is a better conductor of sound than air.

Five per cent. of carbolic acid gas in the atmosphere is dangerous to life.

The horse has a smaller stomach proportionately than other animals.

Spiders break off their webs and remove them before the approaching rains.

The sense of human smell will detect the odour of a 13,000,000th part of a grain of musk.

Vanilla, the fruit of which forms the well-known aromatic, grows wild principally in Mexico.

Cork is the bark of a description of oak tree which grows in great abundance in Spain, Italy, and France.

A hollow cylinder with moderately thick walls is stronger than a solid rod containing the same amount of material.

The most frequent rain-forming altitudes of the clouds is from 5,000 to 10,000 feet above the surface of the earth.

No body that has hitherto been discovered is absolutely transparent. Even in traversing our atmosphere some light is lost.

It is supposed that freckles are produced by the iron of the blood which becomes fixed in the skin through the chemical agency of the sun's rays.

Ice is not the only instance of water existing in a state of solidity. Water becomes still more solid in combination with lime and other earths.

The reason why the eyeball is white is that the blood vessels that supply its surface are so very fine that they do not admit the red corpuscles of the blood.

Sleet is a modification of snow which in falling has met with a warmer current of air than that in which it congealed. It therefore partially melts and forms a kind of wet snow.

Gutta-percha is obtained from trees of the class known as Sapotacea. Its proper name is Gutta Pulo Percha. Gutta means gum, and Pulo Percha is the island whence it is obtained. Gutta-percha is not, however, a gum in the strict sense of the word.

It is estimated that there are about 2,700,000 perspiratory glands distributed over the surface of the human body and that these glands find outlets for their secretion through no less than seven millions of pores.

Some years ago a London optician made a large burning lens, three and a half feet in diameter and employed another lens to reduce the rays of the former to a focus of half an inch in diameter. The heat produced was so great that gold, iron plates, and even stones were instantly melted, while sulphur, pitchand resinous bodies were meltedunder water.

The blood circulates once through the body in about two minutes. If therefore we estimate the amount of blood at an average of twenty-four pounds, it follows that no less than twelve pounds of blood pass through the heart every minute; supposing therefore that the blood could move with equal force in a straight line it would pass through one hundred and fifty feet in a minute.

The enormous mass of extra dead weight due to the carrying of the boiler, fuel and water in the old locomotive will be entirely unnecessary in the railways of the future, which will be propelled electrically. Unquestionably the future electro-locomotion will show a motor on every axle, or, at any rate, upon two axles of each car, and every car running as a unit, in which case they can run coupled together in a train or not, as may be convenient.

The cubit of the ancients varied among different peoples. It is the length of the human arm from the elbow to the tip of the middle finger. According to the most recent investigations, the Roman cubit was 18.47 inches in length, the Greek 18.20, and the Hebrew from 20.24 to 21.88, the variations being due to the age and the locality in which the measure was employed. There is a like variation from 20.47 to 20.74 in the length of the Egyptian cubit.

A correspondent says:—"A friend of mine, a careful observer, recently related an occurrence he witnessed some years ago. While watching fish through clear ice in shallow water, he saw a musk-rat moving about on the bottom, apparently feeding. Presently the animal stopped and emitted the air in his lungs, which came up in small bubbles to the under surface of the ice. He then came up, put his nose to the large bubble, and rebreathed the air. This may be old, but it was new to me, and may be to others."

Assuming the population of the world, according to the latest estimates to be about 1,450,000,000, it is estimated that 1,050,000,000 are non-Christians, and of course 400,000,000 only are Christians. Estimates of such matters are usually crude, but according to the most reliable, if such figures are reliable at all, of the non-Christians, 400,000,000 are Buddhists, 250,000,000 are Brahmins, 180,000,000 are Mohammedans, 150,000,000 are idol, or fetish worshippers; there are 8,000,000 Jews, and 62,000,000 are classed as miscellaneous. Of Christians, the Roman Catholics are estimated at 175,000,000 the Protestants of all denominations at 120,000,000, the adherents of the Greek Church at 90,000,000, and 24,000,000 are classed as miscellaneous.

An article in a recent number of the Hobart *Mercury* gives some curious facts concerning the development of a new sort of nail in the rabbits of Australia in consequence of the animal's endeavour to climb over the wire-netting used to impede its progress in travelling. The farmers have discovered that the rabbits can burrow under the netting, unless it is buried some six or eight inches under the soil. Moreover, they can climb, or evidently intend to do so, after a little training, and to this end they are developing a nail which will enable them to hold on while progress is made upward. This nail development has been noted before in Queensland, when the bark just out of reach was desirable of attainment, but to effect hand-over-hand nautical climbing shows the rabbit in the act of elevating himself in the scale.

HOW TO PROLONG LIFE.

Dr. Ebstein, of Goettingen, delivered a long discourse on this subject, from which we take the following :

The question as to the natural duration of life is first to be answered. According to the latest discoveries, the average length of life, in the natural order of things, is from seventy to seventy-five years. Women live somewhat longer than men. The mortality among children, particularly less than a year old, is very great. From the age of puberty till the fifteenth year the death rate is small ; from that time it becomes greater each year. Too great an old age is a questionable blessing, because a renewal of youth can be reached in no way whatever. It is evident therefore that the normal limit of the age of man is that which is attained without bitter breaking down and suffering. The first condition is a good foundation, a descent from parents physically and mentally healthy. Of further importance is suitable maternal care of the child. Then comes the school and gymnastic training for the increase of the powers of resistance. In advancing life, a proper activity must not be neglected. "An unused life is an early death." The correct means toward reaching a good old age were given by Moltke, when that question was going the rounds. These were "temperance and work." Not only temperance in regard to eating and drinking, but the same must be practised in every direction. A great number of deaths in the prime of life occur through accidental wounds. (In business and industrial life and in war.) Another part on account of so-called constitutional illnesses, which are generally the result of some innate physical defect of the human body. These can always be combated. A third part result from contagious diseases. The danger of infection can generally be met by capable measures of defence. The art of lengthening human life has made little advance up to the present time. The age of man, in the average, has become no greater. Also the common principles of long life have been substantially the same in all times, only the relationships of culture and differing eras imply different occurences and details. Dr. Ebstein also insists that the use of alcohol is entirely unnecessary, and that the danger of shortening human life is not to be found in the greatness of intellectual work, but in its unsuitable organisation.

AN AWKWARD DIAMOND.

A diamond that cannot be polished is hardly an article of luxury, but is, nevertheless, of some value as a curiosity. The diamond usually yields to the efforts of the grinding tool, which makes several thousand revolutions in a minute. However, Messrs. Tiffany & Co., the large jewellers of New York, had to confess themselves beaten, some time ago, by a diamond which had been submitted for a hundred days to a grinding wheel, worked by foot, making 28,000 revolutions per minute. The diamond came out of this ordeal in precisely the same condition as before it was touched. The total distance represented by the revolutions of the grinding wheel was equivalent to three times the circumference of the globe, and in this special instance, the ordinary weight of 2 lbs. was replaced by one of 40 lbs. ; the only effect of the combat was to put the lapidary on the sick list from exhaustion. After this experiment, Mr. Tiffany gave the task up as hopeless, and sent the diamond to the Scientific Institute of New York.

TO INVENTORS.—Anyone having a good Invention can, on applying to the Editor, "Science Siftings," obtain the advice and assistance of a well-known Patent Expert, free of charge.

THE BIRTH OF LANGUAGE.

Philologists and others interested in the origin of language and the development of intellect find very striking analogies between the development of speech and intelligence in the race and in the child, and have obtained some very valuable hints as to the laws determining the growth of language. Scientific psychologists and educators have also gained many important truths from the study of children. A much more extensive and detailed study, however, is now necessary to further progress in either line.

The first thing to be done in every scientific investigation is to collect a large number of reliable facts, from which generalisations may be made and theories found that will guide the investigator in further researches, and lead to the discovery and unification of a general law of nature that can usually be turned to practical account by the inventor, educator, or legislator. Facts of every kind in regard to development of intelligence in children and their progress in language are important, and in the earlier stages of the investigation the common and ordinary facts rather than the unusual and extraordinary are the most valuable.

The number of words used by children two years old differs considerably, but is usually larger than parents suppose. The number varies from a very few words for the child who is backward in learning to talk, though perhaps not less intelligent otherwise, up to a thousand words for children more precocious in that particular. From two to four hundred words is the more common number.

The rate at which new words are acquired varies greatly for different children and at different ages. After they are once fairly started in learning language, it is usually quite rapid, especially with those who are late in beginning to talk. For children just past two years of age, from sixty to one hundred words per month seems to be a common number. If new words should continue to be acquired at this rate until maturity, as they probably are by those who study and read much, an adult would have a vocabulary of from 15,000 to 25,000 words. The additional words used by a child do not represent all of his progress in language. He may have learned the meaning of many words he has had no occasion to use ; he may have learned something about forming plurals and the different parts of verbs, and considerable about how to put words together in sentences. The progress in the latter respect may be shown by keeping a record of his characteristic attempts at sentence making, being careful to omit sentences that are evidently repeated from memory.

The part of speech most used by children seems to be the noun. About 60 per cent of the words in the English language are nouns, 22 per cent adjectives, 11 per cent verbs, and $5\frac{1}{2}$ per cent adverbs, while conjunctions, prepositions, and pronouns form but an insignificant portion of the whole. In an ordinary vocabulary, taking "Robinson Crusoe" as the standard, the proportion of nouns is smaller, and in a still smaller vocabulary there seems to be occasion for the use of a greater variety of verbs than nouns, and a necessity for the use of a number of prepositions, pronouns, and conjunctions. On a page of "Robinson Crusoe" containing 215 different words, but 24 per cent were nouns. Hence the fact that in a child's vocabulary of a few hundred words from 55 to 85 per cent of them are nouns, while but few of the prepositions, pronouns, and conjunctions that it hears repeated so frequently are used, is quite significant. Nouns, however, are not always learned easier and earlier than other parts of speech, for such a verb as "come" or adjective as "hot," may be among the first words learned. Any word which can be associated with a distinct, sensible experience can readily

be learned, but abstract terms are not found in children's vocabularies.

General terms are used by children, at quite an early age, with some degree of correctness, though of course all that is connotated or included under a general term is not understood by any one until its scientific meaning is known. A general term is applied to all individuals having certain characteristics, though they may differ in other respects. The accuracy with which a child uses general terms depends upon the distinctness of his ideas of the special characteristics to which the term is applied, and his power of noting and discriminating those special qualities among a variety of others. His attainments in these two respects are limited by his previous experience. A child who calls a goat a "dog" may lack in clearness of conception of the characteristics of dogs, or in his powers of discrimination, or only in experience. In the latter case he classifies it with the group of animals it resembles more closely than any others with which he is acquainted. A child of twenty-six months who found a small crab in her oyster soup classified it at once with the group of animals it seemed to her to most resemble, and called it an "insect" then performing a considerable act of inference, she gave it the more definite name "oyster-insect." A little girl of less than eighteen months, who learned the word "cut" in connection with the use of a knife, not only called all knives "cutie," but applied the same term to shears when she saw the same operation performed with them, and later to a sickle with which grass was being cut. Nothing is more interesting or important in the study of children than the way in which they generalise, classify, and infer, and instances of such childish judgments and inferences, so odd to us, yet really so natural and logical from their point of view, should be carefully noted and recorded.

Children sometimes form a language of their own entirely different from that of their parents. This is more likely to occur with children of the same age, especially if they are alone together much. Instances are known of children forming apparently quite complete vocabularies, and using no other for several years. This tendency to originate language is shown in almost every child by the invention of new words or new uses for words. New terms are often formed by imitating the noise made by the animal or thing named, as "bow-wow" for dog, "choo-choo" for locomotive, and sometimes by the repetition of a sound made in performing an act, or an emotional sound made at sight of a new object or act. Any sound thus associated with an object, act, quality, or state of feeling may be used by the child as a word, and, if the parents or playmates accept it as having a certain significance, it becomes fixed as a permanent part of the child's vocabulary.

Baby talk, or the peculiar pronunciation used by children, and frequently imitated in literature, is a subject of considerable interest. How much of what is given as "baby talk" has really been originated by children? How much of the incorrect pronunciation of any particular child is due to his inability to pronounce correctly, and how much to the foolish habit of mispronouncing words when speaking to children practised by so many fond parents? Of still more importance is it to know whether there really is any general law of mispronunciation that may be of practical value to the educator. In the first place, it must be understood that the ability to pronounce words is entirely independent of the ability to understand their meaning, and either capacity may be developed in advance of the other. However, in the acquirement of new words, difficulty of pronunciation may exercise some influence in preventing the adoption of certain words into the vocabulary. Not all children are influenced in this way; some adopt difficult words but use a sound easily pronounced in place of the one they cannot pronounce, sometimes following a regular system of substitution. The law of mispronunciation proposed by Noble seems theoretically quite probable, and some of the facts support it, but not enough have been collected to establish it. He reasons that correct pronunciation depends upon clear perception of the sounds to be uttered and a knowledge of the motions necessary to produce them. The knowledge of the proper movements to be made are partly gained by watching the motions made by others in speaking. On imitating the sound the errors in movement are detected and corrected by comparing the resulting sound with the sound heard. The sounds then that are most distinctly pronounced and requiring movements that are the most clearly visible will naturally first be learned and be most clearly pronounced. Those made in the front part of the mouth, such as labials, and dentals, fulfil both of these conditions, while those made in the back part of the mouth usually fulfil neither of them. This law, if approximately true, must yet be modified by the fact that children can usually make every one of the elementary sounds used in language before they begin to talk. The difficulty in pronouncing a word is not to utter the elementary sounds of which it is composed, but to properly combine them. As in learning other complex series of motions, it is not a question of making any one motion, but of properly co-ordinating a series of simple motions. No one has any difficulty in pronouncing such words as "three," and "gray" and "geese" separately, but many do in pronouncing them rapidly one after the other. For a similar reason a child who can pronounce perfectly a sound in one word is wholly unable to utter it in another. Besides this, sounds are modified somewhat by the sounds that precede and follow them. Almost every one also slurs some sounds in his pronunciation, and children frequently notice and try to imitate only the most distinctly pronounced sounds. They therefore often mispronounce, not from inability to utter the sounds, but because they have failed to notice some of the less perfectly pronounced ones. Since sounds made at the beginning of words are least modified by other sounds, mispronunciation can best be studied in the initial sounds of words. The letter with which a word begins usually, but not always, indicates the sound. The following is the order for the letters appearing most frequently as initial letters in children's vocabularies: s, b, c, p, t, w, d, m, h, f, r, l, g, n. To understand the significance of this, it must be compared with the order of frequency for the difficult letters in the dictionary (s, p, c, a, t, b, r, m, d, f, e, h, l, g), and in "Robinson Crusoe" (s, c, p, a, f, b, r, m, e, t, w, h, l, i, g). One of the most marked differences is the greater number of words beginning with the labial and dental b and d to be found in vocabularies of children.

A PRETTY use for cobalt and nickel salts—which as is well known, are effected by changes in the amount of moisture in the air, and which change they indicate by exhibiting different colours—is suggested by Rueckert in the *Rep. Annal. Chim.* If window panes, or wall-paper, or the like, are painted with the following solutions: (1) Chloride cobalt 1, gelatine 10, and water 100; (2) Chloride copper 1, gelatine 10, and water 100; (3) Chloride cobalt 1, gelatine 20, water 200, nickel oxide 0·75, chloride copper 02·5—they will be colourless in damp weather. In clear weather, solution number one will give blue colour, number two yellow and, number three green.

THE LONDON SMOKE PLAGUE.

The origin and dangers of the London smoke plague have just been dealt with in a very interesting and comprehensive fashion by Mr. B. H. Thwaite, C.E., A.M. Inst. C.E., F.C.S. The author also advances a remedy, which is most desirable, although not novel. He proposes to supply the metropolis with gas, produced directly at the coal fields, by means of pipe lines extending to London. Mr. Thwaite draws our attention to the fact that at early morn, before the workshops are opened, and domestic and restaurant fires are lighted, London has a clear and pure atmosphere occasionally as bright even as that of Paris, and always far more bracing and vigorous, but this clearness is dispelled at the beginning of the clang and clink of hammer and shovel, and the jar and rattle of the wheels of industry and the expedients of domestic work. Why should this be? To ask this is like a cry of interrogation in the wilderness. It should, however, be the duty of every citizen to ask this question and demand an answer, but that which is everyone's duty is too often accepted as meaning no one's, and so it is that year after year the same conditions of atmospheric gloom prevail, and year after year architectural beauty is ruthlessly destroyed, and internal art decoration in all its forms is more or less sullied and disfigured, and the labour involved in maintaining domestic cleanliness is enormously increased. But all this inconvenience and the destruction of domestic comfort and the loveliness of art is overshadowed as a damning indictment by the more serious one, which declares that no contagion has a more destructive influence on the well-being and stability of men's lives than the smoke-laden fog of London. Let us analyse the causes constituting this latter characteristic. The sun is the source of life, and under its radiant influence life becomes brighter and all nature is glorious, but the smoke layer intervenes between the dwellers of the metropolis and the solar source of light and life, and this absent invigorator means death for many a delicately constituted life.

A glance at a graphic mortality diagram is more impressive than the mere recapitulation of numerals. It will be seen that a sudden rise in the death line occurs during the period when the full effect of smoke production of London is more directly felt, or when the barometric change of pressure and the change of temperature produce what is known as the "London fog." The average weekly rate of mortality during the prevalence of fogs is nearly doubled, whilst the deaths traceable to diseases of the respiratory organs are far more than doubled. Of course the effects of the smoke-laden fogs are more marked in the case of persons of advanced age. Mr. E. Hart, editor of the *Sanitary Record*, stated before the Select Committee of the House of Lords on Smoke Abatement and Prevention in 1887, that in a fortnight of heavy fog in 1886 the mortality rose to 40 per 1,000, a rate equal to that of the great cholera year. The fog lately prevailing in the metropolis, although not abnormally dense, gave sufficient evidence of its deadly effect. The mortality rate, which attained the figure of 17·4 for the previous week, rose to 20·5, the average rate of the few weeks before being only 16·6. In more salient figures this means an increase of 269 deaths in the previous week, and of 399 deaths per week on the average of the five weeks. The death record of a single day in the metropolis owing to an ordinary smoke fog may be estimated at between 170 to 200. If a railway accident produced an equivalent disaster, what an outcry there would be for means of prevention and what determined legislative action would follow!

It is the aged who demand our fostering care, and who suffer the most. Their lungs are not sufficiently vital to withstand the combined effects of the frozen aqueous vapour and its accompaniment of sulphur and carbon in atomised form; consequently a lowering of the animal temperature and vitality, followed by a reduction of the work of oxidation of the blood, soon brings the enfeebled life to its close, a life that in many instances is precious to the nation, and often deserving the tenderest care for the good it may have done. The increased weight of the vapourous particles due to the addition of carbon and sulphur increases *pari passu* the specific gravity of the particles of frozen aqueous vapour, and they fall to the breathing level with constantly increasing density, and it is not at all improbable that some day an abnormal condition of the atmosphere may produce such a dense condition of fog as to endanger the lives of all those who are unfortunate enough to be enveloped in its deadly embrace.

Some salient figures may demonstrate the physical proportions of this modern London plague. A scientist who has given considerable attention to the subject calculates that the daily fog hanging over London weighs 300 tons, 50 tons of this amount being carbon and 250 hydrocarbon. This, converted into sterling value, is equivalent to an annual loss of £2,000,000 sterling, or in other words, London citizens pay £2,000,000 sterling for the privilege of possessing this deadly and daily accompaniment of their lives. What a satire on our industrial, scientific, and sanitary progress!

The principle of the conservation of energy is in no instance more profoundly or more impressively expressed than in connection between the animal and vegetable world, and the intermediate action of oxidation which is involved in this connection. In animal life the oxidation of the carbon produces carbon-dioxide, the carbon of which is absorbed by the leaves of the vegetable elements. The oxygen is returned to the atmosphere, to be again absorbed by the animal world; the carbon and nitrogen forming the structure of the plant or vegetable is also absorbed in fruit form by the animal world, which gives these elements back again to the vegetable and plant life, the carbon in gaseous form as carbon-dioxide, the nitrogen in liquid form as ammonia or in solid form as nitrogenous matter. In the flame combustion of the vast stores of coal once constituting primeval forests, the same action of oxidation goes on as if the vegetable elements had been consumed by animal absorption; and if the flame combustion were as perfect as it is by the animal action, the result of this combustion would be the separation of the nitrogenous results from the carbonaceous ones, and both would be separated for fertilising the vegetable world in a liquid, solid, or gaseous condition for the ultimate benefit of animal life. Thus the two lives, animal and vegetable, are dependent upon each other for mutual continuance of existence. To realise the full majesty of animal life one has to see the jungles of the equatorial forests, when the two kinds of life in magnificent proportion mutually foster each other; but are these natural conditions of mutual interchange in existence as they should be in our artificial methods of life? Our modern Babylon has not the wondrous hanging gardens of its mighty and ancient prototpye. Yet London was not always the city of sombre hue; not very many years ago prize roses were grown in Camberwell. That colour of all others so natural and refreshing to human eyes, the verdant green, in all its lovely varied tones and shades, cannot now be seen in London in its pristine purity. There is a dirty caricature of the exquisite hue, that is all. It is indeed

strange that even this parody of natural beauty of colour exists. Nature, however, is so persistent that if there is a vestige of chance it is taken.

Mr. Thwaite shows us the woefully extravagent waste of coal that goes on "in flagrant violation of the great natural order of the conservation of energy." Again, the nitrogen in its compound form as ammonia sulphate is extremely valuable to agriculturists, but tens of thousands of tons of this fertilising agent are annually thrown into the atmosphere of London, while we ransack Chili and Peru for the mineral substitute. Then there are the loss of the tar compounds, the weight of fuel lost in transit, and the wear and tear of stock used for carrying purposes; besides freight and middleman profits.

The solution of the problem is to supply London with gas generated in the coalfields of South Wales, South Yorkshire and Staffordshire, and to save the cost of bringing coals to London by using "Gaseous Fuel," in imitation of the natural gas system of distribution in use in Pennsylvania and Ohio. We have already advocated in these columns the generation of energy at the pit's mouth, and we think that Mr. Thwaite's scheme which is fully elaborated in the publication from which we have quoted, is one that commends itself for practicability. That London will ultimately be compelled to adopt something of the kind goes without saying, although, of course, there are other ways of coping with the difficulty. We would refer our readers for these to the suggestions of Mr. J. D. McPherson which we published in our last issue.

ARSENIC AND AMMONIA.

The slow absorption of many poisons changes in some more or less modified form the complexion, but arsenic and ammonia show their effect about as quickly as any. The popular belief that arsenic clears the complexion has led many silly women to kill themselves with it in small, continued doses.

It produces a waxy, ivory-like appearance of the skin during a certain stage of the poisoning, but its terrible after effects have become too well known to make it of common use as a cosmetic.

The effects of ammonia upon the complexion are directly the opposite to those of arsenic. The first symptom of ammonia poisoning which appears among those who work in ammonia factories is a discolouration of the skin of the nose and forehead. This gradually extends over the face until the complexion has a stained, blotched and unsightly appearance. With people who take ammonia into their systems in smaller doses, as with their water or food, these striking symptoms do not appear so soon. The only effect of the poison that is visible for a time is a general unwholesomeness and sallowness of the complexion.

Many people are slowly absorbing ammonia poison without knowing it. The use of ammonia in the manufactures has greatly increased of late, and it is unquestionably used as an adulterant in certain food preparations. Official analyses have plainly shown its use even in such cheap articles of every-day consumption as baking powders. The continued absorption of ammonia in even minute quantities as an adulterant in food is injurious, not merely from its effect upon the complexion, but because it destroys the coating of the stomach and causes dyspepsia and kindred evils.

Professor Long, of Chicago, is our authority for the statement that, if to fifty million parts of water there is one part of ammonia, the water is dangerous.

TO TALK OR NOT TO TALK.

There is a reserve in speech which is no more than dullness. George Eliot says that while speech often has little wisdom, silence also not necessarily broods over a full nest; and goes on to say th at your still and solemn fowl may blink wisely "on one a ddled nest egg, and when it takes to cackling will have nothing to announce but an addled delusion." Also, there is an overflow of mind and lack of reserve which, though not dullness, to be sure, still is great want of discretion. We have known a man who did his thinking aloud. He was an impressive ethical spectacle, for in spite of turning his bosom's counsels inside out for all to see who would, he had very good and thrifty results in life: which we say is impressive, because it shows how far simple honesty will go, and avail where cunning is lacking.

There is also a reserve which is wisdom and strength. Scielermacher said of a friend, a noted scholar, that he "was silent in seven languages," which was immense praise, for as so learned a man had stores to offer, if he was silent it showed that he thought silence no little eloquence and a strong means of impressions. Reserve is the language of wisdom very often because it is self-control. What more miserable than to be leaky of every purpose, counsel, thought and hope within one. Carlyle avers that "he who can not withal keep his mind to himself can not practice any considerable thing whatever."

If reserve be a strong faculty and wisdom, there must be great usefulness in it. therefore it will be well to set forth the reasons for it. For we suspect there is hardly any other virtue more lacking. Indeed, men may be called babblers for the most part, unable to know when to keep silent, even so as to refrain from speech when they can speak only folly. It is sure that a due silence is rarer than good speech, as much as good speech is rarer than poor.

It is a reason for a good economy of tongue that a just reserve will keep away bad topics, such, for example, as sufferings, pains, aches, sickness, hurts, accidents, all of which should be let lie where they fall as much as possible, certainly not shoveled into baskets as it were, lugged into cheerful houses and emptied before bright fireplaces. This is a point of which truly one should either speak much or else in a little speak forcibly for it needs to be brought home to people closely till they become ashamed of such worthless matter in their talk, and not only worthless but uncomely. In truth it is very strange what a pleasure people take in painful matters of conversation. We know not how to account for it. If they rolled about in their mouths only their neighbour's pains and ills, one might explain it by a malevolent, sweet taste they found in other people's misfortunes; for it is often enough seen, though sad it is, that another person's sour makes sweeter our sweet. But this explanation comes to naught when we perceive that persons enjoy as much the rehearsal of their own miseries as those of others. 'Tis said this is because they seek sympathy; but it is to be answered that it were much better for them te seek sympathy in their joys than in their griefs, and especially in their pleasures than in their little aches. Now this unlovely looseness will be braced up and set right by a spirit of reserve, and with great gain to all good company, as we have said: for even if joys be less set flowing by reason of reserve, it is better so than that there should be a muddy flood of aches and miseries. Besides, there is a deal of talk which is mere chatter, garrulity, vocalisation, not much better than a monkey can do, and not near so fast. Truly, speech is so great a gift and wonder that we know not whether it can be treated too solemnly. However it be used to express joy, gaiety, glee, frolicsomeness,

sports, laughter, yet these are fine pieces of sense and reason worthy to be clothed in beauty, as speech may do; but sad it is to see talk put to some uses which are like flinging a king's ermine on a fool.

It is another virtue of reserve that it is a short cut to much knowledge. To hear is to acquire, to listen well is no little study. Good hearkening is reading by the ear. The ear has shape like a dipper, and draws up no little from the well of knowledge, the which, if we be not careful, the mouth is but a spout to lose again. To talk, unless it be wise and with good reserve, as much expends knowledge as good hearing gathers it, and if the tongue clatter very fast there will be left neither time nor stillness for hearing. It was a saying of Zeno: "I hear other men's imperfections and conceal my own," which is to say that the philospher gained knowledge and used it to improve himself instead of spouting it forth in such a manner that his own weaknesses were washed forth with it. A man who knows too much of us commands us. There is a saying of Franklin: "To whom you betray your secret you sell your liberty." For if he know what we would have none others know, 'tis he who may decide for us thereupon whether others shall know or not; and if it be a little secret of sentiment, or joy, pleasure, innocence, yet he may forestall us therein everywhere, "pluck out the heart" of our relation with others and get before us in many pleasant confidences. It is bad when we can not tell our own news. Now, plainly this is to be avoided completely only by never telling the news to any one; but this only means that a just spirit of reserve will be the cause of our choosing wisely where to trust, to the end that though he who has a knowledge of us may command us, yet he will not, being of a worthy nature and a good choice. The matter of choice is of the first importance, for it is plain that to be unreserved where we would is to be so where we would not if we have put our wine into a cracked vessel.

It is no little praise of reserve that success is helped much by silence as to our designs. It has been said well "perhaps more has been effected by concealing our own intentions than by discovering those of our enemy;" for we may be sure always of two kinds of persons about us, or at least great danger of them, first those who gladly will thwart our designs if they know them, and, secondly, those who will seize them for themselves and get beforehand in them if they can. There is an old proverb, "If my shirt knew my design I would burn it," and we know not but its sense is as sound as it is homely.

It is high value in reserve that if we be reserved we obtain thereby great power when we do speak. The speech of the much-silent is likely to have many graces and forces. For it will have the power of a rare and unexpected event; also, it is like to be well considered, and hence valuable in very truth. Again, the habitual silence will defecate the speech and make it terse; and withal it will lose naught by over-speaking and saying too much, which is a very common error. Once we heard a man say of another. "He talked me into great interest in him, and then he talked me out of it." "Be silent," says Pythagoras, or say something better than silence." In accordance with this wisdom, Bacon explains the old fable of Cassandra that, being beloved by Apollo, and first enticing him till she had drawn the gift of divination from him, and then sending him packing, he, since he could not take back the foresight she had obtained, revenged himself by ordaining that no one should believe her soothsayings. Bacon says; "This fable seems to have been devised in reproof of unreasonable and unprofitable liberty in giving advice and admonition; for they are of a forward and rough disposition, and will not submit to learn of Apollo, the god of harmony, how to observe time and measure in affairs, flats and sharps (so to speak), in discourse, the differences between the learned and the vulgar ear, and the times when to speak and when to be silent; such persons though they be wise and free and their counsels sound and wholesome yet with all their efforts to persuade, they scarcely can do any good."

In some reserve is power, tattling is weakness. Therefore live by rule and principal in this matter, and let the rule be, telling nothing to most, tell little to many, and of the little not misfortunes, and still less follies; tell much to a few. And happy is he who hath one to whom he may strive to tell all and wish to tell what is beyond telling.

GEORGE STEPHENSON'S APPRENTICE DIES.

The death has taken place, at Wickham, of Mr. Frederick Bailey, fitter, the first apprentice to George Stephenson, the eminent engineer. The deceased had reached the advanced age of 91 years. He was born at Gibside Hill Head in the year 1800. His father often met Stephenson, and became intimately acquainted with him. Stephenson often advised him to send his son Frederick to learn the engine building trade, but he never consented to do so until a simple incident occurred which filled him with a great admiration of the Killingworth engineer's mechanical genius. Mr. Bailey had an old clock which he prized highly. It happened to get out of order, and he mentioned the fact to George Stephenson. The latter came up to Gibside, where he took the clock to pieces, and set it to work again as well as ever. The owner was delighted, and he determined then to put his son under Stephenson as an apprentice. Young Bailey went to Killingworth, and remained four or five years. Of the life of George and Robert Stephenson there he remembered a good deal. Bailey used to remark that a great many people about Killingworth actually wished for Stephenson's death at the time he was deloping the locomotive engine. These were mainly owners of horses, whom the locomotive had deprived of a profitable occupation. There was nothing remarkable in Bailey's own career. About 60 years ago he went to South America for a time, and on returning continued to work at his trade till he became too infirm.

THE WONDERS OF NATURE.

Amid all the wonders of nature there is none more startling than that which reveals to our knowledge the fact that a flint stone consists of the mineralised bodies of animals, just as coal consists of masses of mineral and vegetable matter. The animals are believed to have been infusorial animalculæ coated with siliceous shells, as the wheat straw, inclosed with a glassy covering of silica. The skeletons of animalculæ which compose flint may be brought under microscopic examination. Geologists have some difficulty in determining their opinions respecting the relation which these animalculae bear to the flint stones in which they are found. Whether the animalculæ in dense masses form the flint, or whether the flint supplies a sepulchre to the countless millions of creatures that ages ago enjoyed each a separate and conscious existence, is a problem that may never be solved. And what a problem! The buried plant being disentombed after having lain for ages in the bowels of the earth, gives us light and warmth; and the animalculæ after a sleep of ages dissolves into the sap of a plant and wraps the coat it wore probably tens of thousands of years ago around the slender stalk of waving corn in the fields of to-day.

PHRENOLOGY EXPLAINED.

By Stackpool E. O'Dell,
Author of "Phrenology: its Truthfulness and Usefulness," "Old St. Margaret's," "Merciful or Merciless?" "Brompton Lectures," "Mental Troubles," etc.
[RIGHTS RESERVED].

IX.

The organ of Time is situated above that of order and between those of eventuality and tune. An apportioning or measuring and knowledge of time is a mental characteristic of human beings. The utility of this faculty enters into our everyday life. It is likewise of much importance to the higher branches of science. Its uses should be made a matter of study, so that we shall place more value upon it and be more desirous of cultivating it. In fact, when we come to consider any item of mental capability we are almost overwhelmed with its importance. Time and space are intimately connected: we have a simple illustration of this in the dial of a clock, the hands travelling through space marking time. Time is likewise marked by sensations. The change of one sensation for another often draws our attention to the lapse of time. Daily wants, occupations and customary events measure out time for us. Space between breakfast and dinner is marked by hunger, this space we call time. This faculty is specially required in astronomy, chronology, and many sciences where time is a factor for observation and deduction. For instance, the astronomer wants to know how many seconds it will take for a ray of light to travel a certain distance, and makes from this observation calculations of immense value. The proper arrangement of time helps us considerably in our every-day life, business and social arrangments. There are some people who demonstrate by their actions the dormancy of this faculty, they have such little knowledge of the lapse of time; though they may be orderly in other matters, they have neither method nor arrangement in the proportioning out of time. They seem to be unable to perceive or value the distance between one period and another. The ticking of watches and striking of clocks is scarcely enough to arouse this faculty from torpor to the fulfilling of engagements. Just one moment, just one word, they beseechingly ask for, but their faculty of time is so small, that while the word becomes many, the moment passes into an hour: then there is the exclamation. "Who would have thought it was so late!" This want of being able to measure the duration of time oftens interferes with both happiness and success. When this deficiency is perceived, an effort should be made from day to day to learn how to calculate the lapse of time, even independently of artificial time-keepers. More attention should be paid to the timing of the day's transactions, allotting when possible for everything its own special time, and being punctual to the arrangement. Time, we all know, is very important in music, and causes much difficulty in learning to those who are deficient in the faculty. When this faculty is small, it is almost impossible to become an acceptable player, although an individual may like music in no small degree, and may be pleased with harmony; but if he have not the faculty of time, he will not be able to perform, consequently there are those who can enjoy music when played by others, who cannot perform themselves. To hear an air once is quite sufficient for some people to enable them to play it, such will have this faculty strong and active. It is not alone that this faculty is required by musical composers and performers, but by verse-writers, readers, and elocutionists; even in ordinary speaking it gives an amount of taste and judgment in regard to stops and pauses that adds much to conversational ability. The individual who has it prominent will be inclined to utilise time so as to obtain from it the best results. If there is one thing wasted more than another by many it is the valuable commodity, time, which is one chief contributor to all wealth. The individual who has this faculty small is late for all the social arrangements of the household, he is late in his appointments, he repeatedly misses his train, he is generally hurried, and oftentimes confused, while not seldom does he suffer from heart disease. Some people with a knowledge of this fault, manage to be beforehand with everything, oftentimes to the inconvenience of others and loss to themselves through waiting. Half an hour beforehand at a lecture hall or railway station is no doubt better than being late, yet time is wasted. As it is but seldom that injury is derived from the excess of this faculty, except in causing people to be irritably particular in appointments and other time arrangements, there is no need to say anything about its restraint.

HUNGER.

Everybody knows from personal daily experience, what it is to feel hungry, more or less; and also everybody—even the tiny baby in its mother's arms—knows that want of food is the cause of it, and that food is the one and only specific in the world to cure the sensation. But have you ever given the subject a passing thought as to why hunger results from want of food, or an empty stomach; and the reason of the close relation that exists between one and the other? Food is the sustenance of the body you will say, but can you answer—Why? How? and Wherefore? Weakness and death come from hunger, while strength and life are derived from food. Food is the fuel that burns within us, and keeps us alive. The fire in the grate will go out unless you put fresh coals on, and the lamp, unless you fill it with oil frequently will give no light. It is for the very same reason that we partake daily of our regular meals, and that is because we are burning away during every moment of our existence. The air we breathe into our lungs contains oxygen, and this oxygen, in the same manner as it makes the coal in the fire burn, consumes the muscles, and various other organs of our bodies, and so causes hunger. About 30 ounces of oxygen every day, and in every single individual, are thus turned into waste, requiring 12 ounces of carbon, or three pounds of good food to replace it. The heat produced in a man's body in the course of a day is considerable in quantity, though not intense in quality. Taking the average it is enough to raise four and a half gallons of freezing water to boiling point, which is about as much heat as could be extracted from a pound of burning coal. It is evident, therefore, that if we did not eat, in order to make up for the constant waste of she substance composing our bodies, the life within us would soon be totally extinguished.

At the meeting of the Bavarian Society of Applied Chemistry, the subject of the "Presence of Copper in Preserved Vegetables" was under discussion. One of the speakers, Director Kochler, of Berlin, made a remarkable statement. He said that during a visit to the Strassburg Exhibition his attention and been attracted to the remarkably beautiful green of some preserved beans, and upon inquiring as to how this colour had been imparted, he was told that it was a trade secret. Subsequently he had learned that during the boiling of these vegetables in a copper vessel an electric current was passed through the whole, the copper of the vessel acting as an anode, and that in this way a large quantity of copper was carried into solution, giving the vegetable a fine tint.

BREATHE PURE AIR.

One of the saddest sights of our civilisation is the spectacle of disease and pain which confronts us on every side. It is rare indeed to find even an individual perfectly well, to say nothing of families and communities. But why is it ?

Barbarians and savages do not so suffer. May it not be, in part, because civilised communities do not sufficiently avail themselves of the sanitary influences of the air and light ? It is in the hope of helping to answer this question that the following notes of personal experience are herewith given.

A few years ago we read an article which seemed to prove the value of pure air as a preventive of "colds." The theory suggested was that colds may be caused by the loss of a certain equilibrium between the oxygen in the lungs and the carbon in the blood. It is true that this may follow overeating, and so overcharging the blood with food elements; but more frequently, it was thought, the lack of pure air.

By acting upon this theory almost incredible results were said to have been reached. The writer of the article alluded to claimed that he had easily brought himself into a condition in which it seemed impossible to take cold. He could sit in thin clothing in winter at an open window. The ordinary causes of colds, such as wet feet, overheating, and the like, seemed powerless to produce their usual results.

With these statements in mind, we are much interested in some curious facts experienced by a soldier on active service. He was not strong and indeed was hardly fit to be in the army at all. And when he found himself exposed all day long to a steady rain, and at night to the outdoor air, with no fire, no change of clothing, no shelter but a canvas covering open at both ends, through which the rain dripped constantly, it seemed certain that the "death o' cold," so often predicted, must surely follow. Why it did not follow was more of a mystery then, however, than it is now. For he tells us he was in a place where the art of man no longer excluded one of the prime principles of health. He breathed pure air because he could not help it. During a service of fifteen months, with severe exposures, but fresh air constantly, the same immunity from colds prevailed. He remembered, too, that when he came home from the campaign the blessing and the curse—at least one of the curses of civil life—came back together. He had comfortable rooms to eat, breathe, and sleep in on the one hand, but very soon colds, sore throats, and related troubles on the other. This was the second count in the argument for pure air.

Finally, after nearly twenty years of suffering according to the common lot of man, he resolved to try the pure air cure, and from that time to this the windows of his room have been open almost constantly day and night. The result was immediate and striking, and for the last seven years he has not had one serious cold. His sore throats are wholly the thing of the past, and certain other physical derangements not usually associated with colds have also dissappeared.

Like others, he has often to spend hours in crowded rooms. It sometimes happens after such an "exposure," that he suffers for a day or two from a "head-cold." But in every case so far it has proved to be entirely superficial —a natural and easy throwing off of the poison contracted in that crowded room, followed by no serious effect whatever.

At this very moment in the house where he lives there are twelve persons, every one of whom, except himself and one other, is suffering from the effects of a cold. It certainly does look as if the exemption he enjoys is due to the exceptional privilege of the pure air to which he constantiy treats himself. Perhaps it would help the argument to state that nearly all of his father's large family died of consumption.

It should be borne in mind that the difference between the air of an ordinary room in which people live and that of the air out-doors is far greater than is generally supposed. Do but think of the emanations that constantly proceed from every object in such a room—carpets, walls. and draperies. People say : "Oh, yes, we believe in ventilation. We open the windows in the morning and let the air draw through ; and at night we open the doors of our sleeping-rooms. We believe in pure air." And we feel like saying to them : "My dear friends, you know no more of r ealy pure air than the blind mole down in the ground kno wsof sunlight."

We would not by any means advise persons who have been living in a close atmosphere to suddenly sit or sleep in the draught of an open window, although these radical changes are advocated by the great gentleman of whom we write. It is only by degrees that such changes can be made with safety. But by degrees they can be made, and why might not most people begin at least to make them ?

Meanwhile, it is painfully apparent that multitudes of people, sick with constantly recurring diseases of the lungs and related parts, continue to breathe foulness. Is it not worth while to make some effort to change this condition of things ? Perhaps half the money now spent on superfluities, if devoted to a better system of ventilation, might very sensibly improve the health and increase the happiness of the community.

SCIENTIFIC WARFARE.

What will be the military manner of beginning the next great war, assuming that the chief combatants will be France and Germany ? Will it open with conflicts between cavalry and horse artillery on either side, or, as Sir Charles Dilke insists, will the first engagements be between the German cavalry divisions and a perfectly handled body of infantry that defend every farm, wall, stream and wood, and make the advance of cavalry, in these days of smokeless powder, impossible ?

On one point there seems to be no difference of opinion. When men next fight the carnage will be awful. The smoke of battle will be a discarded metaphor, for there will be no smoke, only a transparent blue haze. The thunder of the artillery, too, will be greatly modified, and the vicious "ping," of the modern musket will never, however intense may be the fire, develop into a roar. Low blasts on the cowherd's horn are taking the place of the morning bugle-call. Bright uniforms and glistening equipments are going the way of coats-of-mail and gayly caparisoned steeds. Death on the field of battle will show a more and more pronounced preference for a shining mark.

The peaceful dove has been pressed into the service of war. In France each cavalry division has a cage-cart full of carrier-pigeons. The mounted staff officer has given place as a messenger to corporals on bicycles. The human voice does not carry far enough to be of much use in the command of widely deployed masses of Infantry. It has been superseded by the whistle, by waving of the arm or movements of the cap. The "fire zones," the area within

which modern musketry is fatal, extend wide and far. They are to be crossed by the attacking force only by dodging from cover to cover, or, if in the open, by intermittent rushes. At the best every yard of advance through a steady hail of lead pellets must be bought with human lives.

In preparation for the new conditions of warfare Germany is no longer held to have uncontested superiority. France is once more conscious of having the best private soldier in the world, and, in the words of Sir Charles Dilke, is almost amazed at the completeness of her military recovery. It is the deliberate opinion of this and other observers of European war establishments that the relative strength of France and Germany is a matter which now depends chiefly upon points which can only be tested by war.

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for the scienee sifting of the greatest interest seleeted from any souree has beeome very popular with our readers, but the exigencies of spaee have compelled us to limit the size of these paragraphs to 200 words eaeh, and although we publish some that are longer than this, we cannot in future award the prize to those who do not conform with our rules; if we did, it would be manifestly unfair to those eompetitors who abide by the rules. Many excellent siftings lose the prize for no other fault than verbiage, so we would caution our readers in this respect. Talking of prizes, we are nearly through the mass of M.SS. sent in for the five guinea "Essay on Man in 1991." We trust to award this prize before Christmas; if we cannot, it will be immediately after.

The Great Atlantic Cable

owes its origin to Mr. Cyrus W. Field, and the whole civilised world owes thanks to the man whose faith and wealth gave it to us. He is now, unhappily, lying on a bed of sickness, brought about through financial and social disasters, resulting from the miseonduet of his son.

Nihilism

has at length done something for the world, better than dealing out death to autocrats. The Czar of Russia felt it a neeessity to promote the eomfort of his railway journeys by performing them in an armour-plated train, and the Société Franeo-Russe was given the contract. In order to obtain plates sufficiently large enough to line the earriages, this firm devised a method of produeing sheets of steel 60 feet long by 4 feet wide from a single ingot. Here we have cause and effect—Nihilism and a proeess for making monster steel plates.

The Arc Light

possesses a eurious drawback in the eyes of an Ameriean eontemporary. The arc light earbons frequently possess charaeteristies of the diamond, to which in eomposition they strongly approximate. The pieees of unburned carbons which are thrown away are often found to contain very hard, sharp ends whieh will eut glass, and the mischievous street arabs have discovered this fact and use the pieees for defacing windows and doing other destructive work. We have not suffered this grievous ill as yet at the hands of the *gamin*, but we would willingly endure it if we eould have a little more eleetrie light.

Electricians have a Great Future,

aeeording to Professor Crookes, who recently said of this great possibility of science, that it has been computed that in a single eubie foot of ether whieh filled all space there were locked up 10,000 foot tons of energy whieh had hitherto eseaped notiee. To unloek this boundless store and subdue it to the serviee of man is a task which awaits the eleetrician of the future. The latest researches give well-founded hopes that this vast storehouse of power is not hopelessly inaeeessible.

Modern Research

in the field of light opens up such vast possibilities that even the most reserved must feel sanguine of the future. Eminent seientists consider the problem of utilising one kind of radiation without the others a rational one. In an apparatus designed for the production of light by eonversion from any form of energy into that of light such a result ean never be reached, for no matter what the proeess of producing the required vibrations, be it electrical, chemical or any other, it will not be possible to obtain the higher light vibrations without going through the lower heat vibrations. It is the problem of imparting to a body a certain velocity without passing through all lower velocities. But there is a possibility of obtaining energy, not only in the form of light, but motive power and energy of any other form, in some more direct way from the medium. The time will be when this will be aeeomplished and the time has eome when one may utter sueh words before an enlightened audienee without being

considered visionary. We are whirling through the endless space with an inconceivable speed, all round us everything is spinning, everything is moving, everywhere is energy. There *must* be some way of availing ourselves of this energy more directly. Then, with the light obtained from the medium, with the power derived from it, with every form of energy obtained without effort, from the store for ever inexhaustible, humanity will advance with giant strides. The mere contemplation of these magnificent possibilities expands our minds, strengthens our hopes, and fills our hearts with supreme delights.

The Danger in Impure Ice

has been dealt with somewhat conclusively by Mr. Henry Stewart. He is of opinion that it is always desirable that ice should be gathered from pure water, but when it is used for cooling water for drinking it is indispensable that it be perfectly pure. As a rule the water of a pond is numerously charged with impurities, and ice cut from a stagnant pond, or one through which a slow current only moves, should be used with caution. As a rule, water in freezing separates from its impurities, even those which are held in solution. Thus, salt water freezes into fresh ice, the particles of water separating from the particles of salt. This may easily be made very plain. It is known that the particles of water measure not more than $\frac{1}{3000000000}$ part of an inch in diameter, and there is every reason to believe they are round. When any substance is dissolved in water it is reduced to particles much smaller than the molecules of the water, and these rest in the spaces between the round bodies of which a mass of water consists. Anything held in suspension in water merely lies among the particles of it, being in larger sizes. When water freezes, the exceedingly small particles of which it consists join together and form solid crystals. As they have only attraction for each other, and not for other substances mixed with them, these are pushed aside as the the needle-like crystals are formed on the surface, and these, being lighter than the water, float on the surface. As the ice becomes thicker by the gathering of the minute crystals, any impure matter is forced aside and remains in the unfrozen water. Thus, the ice is pure under the circumstances. But if rain falls, or dew is deposited, or snow covers the ice, or a thin sheet of water flows over it, and these freeze, whatever impurities this water may contain are, of course, retained, and cannot escape to the water below, and ice so formed is not pure, and will contain more or less impure matter as the peculiar circumstances may happen to be.

This Explanation will Help

those concerned to form a judgment in regard to the quality of ice they may gather, and if pure ice cannot be procured, it should be used outside of the vessels in which anything to be eaten or drunk is cooled. When ice is taken from its packing in the ice house and used for cooling drinking-water, it should be washed clean ; and as the coldness of it condenses the moisture of the air upon its surface, when ice is used in a room where sick persons are, it should be washed ; but it is better to keep it elsewhere. No doubt many injurious germs exist in ice, and the worst of them, the various fever and diphtheria germs are not killed by the cold of freezing even during weeks or months. Hence, ice is always to be used with as much care in this respect as water is, or should be.

Evolution,

or anyhow, Darwin's theory of it, enforces on the theorist the necessity to endeavour to bridge over the gaps which are very easily to be discerned betwixt existing classes of animals. Dr. Andrew Wilson thinks no doubt geology has supplied not a few of those "missing links," and has undoubtedly proved, for example, how the modern one-toed horse has descended from a four or five-toed ancestor ; and how birds and reptiles, which every zoologist knows are near kindred, can be linked by at least one fossil bird, which is neither bird nor reptile, but a very decided mixture of both groups. Still, the geological record is an imperfect one, and always will be. If every living thing which had ever existed had been preserved in a fossil state, and had been placed at the disposal of the geologist and anatomist for investigation, there might have been few or no difficulties in the way of piecing together the bits of the puzzle of life. As, however, fossil animals and plants constitute the mere chance preservations of the life that was, we have perforce to be content with a very meagre knowledge of existence in the past ages.

Another Method Remains,

however, according to Dr. Wilson, for arriving at the relationship which science seeks to show exists between apparently diverse groups of animals and plants. In plain language, when we study the development of an animal or a plant, and see how it works its way from the germ to become the adult form, we are brought face to face with a series of changes and scenes which are significant enough to the thinking mind. Suppose we discover that a frog begins life as a fish—a fact every schoolboy knows—what is the meaning of this strange becoming on the part of that tailless animal? Natural history replies that the frog's development we see to-day is really a recapitulation of its past descent. Witnessing how a tadpole becomes a frog, we are really looking at a moving panorama of the rise and progress of the whole frog race, whereby that race must have sprung from a fish-like stock, and must have gradually grown into the lung-possessing, air-breathing creatures of the present time. This seems to be the only reasonable interpretation to be placed upon the marvellous changes which we see represented in the development of animals and plants : and this, at least, is the meaning which science attaches to the unfoldings of form and structure discernible in the course of the living being's progress from its beginning, in the egg, to its assumption of its adult character.

These Interesting Theories

of Dr. Wilson tempt us to further print others of equal interest. In the course of studies in the development of animals we meet with some very curious discoveries and theories relative to the origin of the various zoological groups ; and certain ideas of the origin of backboned animals at large lately promulgated, seem to be worthy of mention. The puzzle of naturalists has been that of accounting for the origin of vertebrated a imals, because these backboned tribes (which range from the fishes to quadrupeds) seem really to stand out very distinctly and by themselves as a specially defined sub-kingdom. The backboned branch of the animal tree, in other words, has presented great difficulties in its being traced to its connection with the parent stem. There is a certain fish, the lowest of its class, called the lancelet, which is found to present, both in its development and in its adult structure, certain close affinities to a lowly tribe of creatures known as *tunicates*, or sea-squirts. A sea-squirt is simply a kind of animated bag with two openings, something like an ancient "leather bottel," which remains attached to a rock or stone. Hence, from the likeness between the sea-squirt's

development and that of the lowest fish, many zoologists are given to regard the former as the putative parent of the vertebrate animals. The sea-squirt, in this view, is the very far-back ancestor (or representative of the ancestor) of the backboned tribes.

Certain Adventurous Spirits

in biology have, however, more recently ventilated new ideas of the origin of the backboned forms, and these ideas, Dr. Wilson fancies, are more startling even to biological minds (given to feel surprised at nothing whatever) than any previous theories which have been advanced. Seeking for the ancestors of backboned animals among the annelids or worms has not been a process attended by success, in so far as evidence of probability is concerned; but higher in the series of jointed or articulate animals we find the insects, spiders, and crustaceans, of which latter class the lobster is a fair representative. One scientist declares that for choice he finds the most likely origin of the backboned tribes in the spider-class. What induces this belief is the tendency to head development, among other signs of advance, which the spiders, scorpions, and their allies exhibit. What we call a scorpion's head is really its head and chest united, and a close examination of this region shows that in the arrangement of its nerve-masses, its nerves, sense-organs, and so forth, there is to be traced a very exact resemblance to the similar arrangements in the vertebrate head. Again, it is held that in the development of the scorpion and spider, essentially similar features to those seen in backboned development are to be traced. So that the far-back ancestor of the highest animals, on this belief, are to be sought for in some primitive scorpion, which, getting on in the world, gave origin to the higher group. There might be a difficulty regarding the transition from air to water—from scorpion to fish—no doubt; but it is maintained that out of a common type of primitive breathing organ the modification in question could easily have occured.

The Other Theory of Vertebrate Origin

also sees the ancestor of backboned animals in some primitive jointed animal or other. Tracing the development of the backboned brain and spinal cord, an observer regards these important structures as having been formed by the elaboration of jointed nerve masses placed on the outside of a tube. There is such a tube in the middle of the spinal cord, and this tube extends onwards into the brain. The bold idea has therefore been formulated that the central nervous canal of the backboned tribes represents the digestive tube of the vertebrate ancestor, certain dilatations of the tube in the brain corresponding to the stomach of that ancestor, whose own nervous system (lying below its digestive tract) has become transformed into the backboned nervous belongings. There is, however, the big liver of the ancestor to be reckoned with. Where has it gone to in the course of the transformation? In the young lamprey it is shown that a kind of temporary liver may be regarded as existing in the brain, and this is looked upon as the rudiment or remnant of the liver which was once the possession of the vertebrate's ancestor. On the whole, it may be said, we are getting on very nicely in biological theory; and, whether we accept the views thus set forth or not, we may at least feel some curiosity in knowing how modern speculation is deriving the vertebrates from lower forms, and how the modern backboned animal is thought actually to carry in its spinal cord the remnant of the ancestral digestive system.

The Adaptibility of Animal Life

to the circumstances under which it exists, may account for so much being heard now-a-days about evolution, for every day brings to notice some fresh wonder in this direction. We hear of men developing special attributes to fit them for a special trade or calling, as a result of having followed that trade or calling for a generation or so. In the Queensland bush there has been discovered, it is reported, a pig, which compelled by the exigencies of its life, has taken to climbing trees in search of fruit and foliage. In Australia the rabbit has already begun to climb trees to feed on the leaves at a time when the grass is withered after long draughts. It is even said, as we stated last week, that the structure of their fore-legs has begun to alter in accordance with the new trait of life. Again, in Malta goats may be seen climbing the carob trees or calmly standing on the branches engaged in devouring the "beans." In Morocco they scramble up the argan trees for a like purpose, and in some of the old Egyptian frescoes they are portrayed in palm trees engaged in dining off the dates. More is scarcely wanting to show how animal formations change when it is incumbent on them to adapt themselves to adverse or favourable circumstances.

The Sinking of Objects

in mid-ocean, when very deep water prevails, has been exercising the wonder of a correspondent. He desires to know if at a certain depth, the density of the water will prevent bodies sinking further. There is every reason to believe that any body that will sink at all will sink to the bottom. The known fact that fishes live at the bottom of the deep seas, that water is but very slightly compressible, and that organic bodies are also equally or more compressible than water, sustains this view. A substantiating fact is known that a wooden whale-boat has been carried down so deep in the ocean by a harpooned whale that when the whale rose to the surface and was captured, the boat had to be hauled up by the line, and was found to be so thoroughly water-logged and compressed by its few minute's dive that the wood had become heavier than the water. Fishes having live elastic tissue are compressed to the same extent, but recover in rising by their own exertion. It has also been stated that whales that have received a death shot and dived have not come to the surface, although watched for during several days.

The Railway Locomotive,

whose gigantic powers appear as if they must take an age to create, can be constructed in a marvellously short space of time. Mr. R. A. Lawson kindly sends us from the "Drawing Office" of the Great Eastern Railway's Stratford Works the following from a contemporary:—"They have just made a record at the Stratford Works of the Great Eastern Railway, where a six-coupled engine and tender have been built in ten working hours. The order was begun at 9 on Thursday morning, and at 9.15 a.m. yesterday the engine and tender were turned out in running order. Allowing for the night's rest, the actual time was within a working day of ten hours. The best similar performance hitherto was by the London and North-Western Company, who erected an engine and tender in twenty-five hours. Of course, the parts were all ready to put in their places, but even then it was a fine piece of craftsmanship, and deserved the hearty cheers that greeted the huge machine as it left the shop.

The Theatrophone

went through a preliminary trial at the Savoy Hotel, a few evenings since. The machines used were similar to the latest which have been introduced into many Paris clubs and

restaurants, and are, it is needless to say, worked on the "coin-in-the-slot" principle. For tentative purposes connection had only been established with one theatre—the Savoy—and by holding a receiver to each ear the music of the opera was heard with purity and clearness, with good volume of sound. This is true not merely of the solos, but justice was also done even to the choruses and orchestra. The spoken dialogue, too, was excellently reproduced, and delicate shades of intonation were not lost. The mechanism inside the boxes is ingenious and complex, for it has only reached its present form by dint of successive improvements, designed to meet the tricks of those who endeavour to hear without paying, or to hear more than they pay for. It is now believed, however, that the mechanician has finally defeated the swindler. There are two slots—one for shillings and the other for sixpences, the rate being 6d. for five minutes' music. Time is marked by a small dial, the total of coin received is automatically recorded, while inadequate coins are contemptuously thrown out through a hole at the side of the box. The present intention is to make arrangements—whether by the formation of a new company or otherwise—for supplying London with theatrophones in the same way as telephones are now provided. Among other developments, it is proposed in Paris to establish connection with the Chamber of Deputies, and to offer at the end of the day a "spoken newspaper," or summary of the events of the day.

The Subject of Flying Machines

is a pointt on which a correspondent would like a little more information. He is particularly inquisitive about Mr. Maxims' machine, and the one being built for the Chicago Exhibition. Naturally the constructive details of these two vessels are a profound secret, and we believe we have already published all that is known about them publicly. Most attempts at flying have resulted disastrously for the experimenters, but one of the most successful machines was that of M. H. de Villeneuve, who has, for over twenty years, been Secretary to the French Aëronautical Society. His device provided only for the transmission of power by a flexible hose from a stationary boiler, no steam engine and boiler of sufficiently light weight being available for experiment. It rose so suddenly upon trial that the inventor became alarmed, and hastily shutting off steam he fell to the ground with sufficient force to smash one of the wings. The experiment, however, demonstrated the fact that, given sufficient power, the machine would rise.

Another Successful Flying Machine

was invented by Mr. L. Hargrave, of Sydney, New South Wales. After numerous experiments with springs, which gave theoretically satisfactory results, this gentleman constructed a screw-propelled aëroplane. It weighed two pounds, and was driven by the contractile power of 48 elastic bands geared in tension. It was self-propelled for a distance of 120 feet, at an expenditure of 196 foot-pounds. Last year he constructed a compressed air machine. The body of the machine consists of a tube two inches in diameter, 48½ inches long, ond weighing 19½ ounces. Its cubic capacity was 144·6 inches, and the air in it was compressed to 230lbs. to the square inch. The total weight of the engine was only 6½ ounces ; the cylinder had a diameter of 1½ inches, with a 1¼ inch stroke of piston. The total area of the machine and wings was 2,344 square inches for a total weight of 2·53 lbs. The wings were made of paper and the elasticity of the frame supplied all that was deemed needful in the way of feathering. In an experimental trip the machine flew 368 feet horizontally, at an expenditure of 870 foot-pounds of energy.

Communication with the Planet Mars

was the condition of a bequest of 20,000 francs by a French lady, who died some months ago. A correspondent now makes some suggestions, which he states he has never seen discussed before. He says : On a moonless clear night, the electric and gas lights over such a large territory as London and its suburbs, must present the appearance to a spectator in Mars of a spot of light on the dark side of our globe. If, now, on such a night, from the middle of some large dark area, for example the German or Atlantic Oceans, brilliant flashes of light be regularly sent forth in certain forms, there would be a chance of its being interpreted by the inhabitants of other spheres, and they might thereby be induced to signal us in return. But there is a bare possibility of direct communication by taking advantage of the meteor currents in the great ocean of space in which we move. If on breaking open a meteorite we should find a chipped flint or other instrument, we should conclude that the portion of space from which it came had intelligent inhabitants. If, now, we can, by the aid of modern explosives project into some meteor shoal a ball of iron containing at its centre some object of human design, the ball might ultimately come to some other planet and be found by its inhabitants. Such a procedure would be analogous to casting a bottle inclosing a message upon the ocean to be wafted by the currents to some intelligent eye. The wild schemes of one generation are often achieved in the next. Jules Verne's "Around the World in Eighty Days" and "Twenty Thousand Leagues under the Sea," have been in a measure realised, and possibly his "Voyage to the Moon" is the next romance to be realised in some form. An initial velocity of seven miles a second would be required to project a body beyond the earth's attraction, and it is not too much to hope that this will soon be attainable at the present rate of progress in the science of explosives. A projectile sent from the earth would have considerable value as a direct astronomical experiment on meteorites, even if it should fail in bringing tidings from another planet.

Life-shortening Occupations

are instances of the extent to which the most hazardous trades are overrun by applicants for work. The electric light companies never find any difficulty in obtaining all the wiremen they need, notwithstanding the fact that the dangers of that kind of business have been demonstrated times without number. The men who work in factories where wall paper is made, frequently chaff one another over the tradition that a man's life, in this trade, is shortened ten years. A similar belief is prevalent in factories where leather papers are made, and among men who have to handle them, and whose lungs are said to become impeded by inhaling the dust arising from such papers. In certain other factories, where brass ornaments and fittings are made, the air is laden with very fine brazen particles, which are, when inhaled, especially irritating to the lungs. But one of the most singular advertised calls for employees that was ever printed appeared recently in a United States newspaper, signed by a firm engaged in the business of building towers. It called for applicants only among those who are young, strong, and courageous, and closed by saying : "We warn all seekers for this job that it is of the most dangerous nature, and that few men continue in it more than a few years. In fact, it is almost certain death to the workman who follows this occupation."

THE PRIZE SCIENCE SIFTING.

One Guinea will be paid each week to the contributor of the most interesting or curious Science paragraph.

The paragraph must not exceed 200 words, and need not be original, but in this case, the source from whence it is copied must be given. All paragraphs must reach us on Monday, and be marked "Prize Science Sifting" on the envelope, unless a postcard be used. Only one paragraph may be sent in by each competitor.

The Editor reserves the right of publishing any paragraphs sent in.

We have awarded the prize of One Guinea to Mr. F. ELLINGWORTH, Northgate Cottage, Oakham, for the leading "Science Sifting." The other siftings published all deserve honourable mention.

Prove that it Moves.

TAKE a good-sized bowl, fill it nearly full of water, and place it upon the floor of a room which is not exposed to shaking or jarring from the streets. Sprinkle over the surface of the water a coating of lycopodium powder—a white substance which is sometimes used for the purpose of the toilet, and which can be obtained at almost any apothecary's. Then, upon the surface of the coating of powder, make, with powdered charcoal, a straight black line, say an inch or two in length. Having made this little black mark with the charcoal powder on the surface of the contents of the bowl, lay down upon the floor, close to the bowl, a stick or some other straight object, so that it will be exactly parallel with the mark. If the line happens to be parallel with a crack in the floor, or any stationary object in the room, so much the better. Leave the bowl for a few hours, and then observe the position of the mark with reference to the object that it was parallel with. It will be found to have moved about, and to have moved from east to west, that is to say, in the direction opposite to that of the movements of the earth upon its axis. The earth, in simply revolving, has carried the water and everything else in the bowl around with it, but the powder on the surface has been left behind a little. The line will always be found to have moved from east to west, which is perfectly good proof that everything else has moved the other way.

Spider versus Wasp.

THE ingenuity exhibited by the common garden spider is marvellous. Not content with spinning a most beautiful web, with great geometrical accuracy, and of a silken fibre which has become almost invaluable to the modern observatory, it makes use of the web it has spun for the capture of its prey in a manner little dreamed of by most people. As a rule its food consists of small insects, such as house flies, ephemera, etc., but I had once the intense delight of watching the ensnaring in the toils of the web of a larger insect, *viz.*, a wasp. When the wasp first struck against the web, the impetus with which it struck, was almost sufficient to carry it through. But not quite; the spider pounced upon the wasp and, unharmed by its sting, proceeded to devour it. But the wasp was no mean antagonist; its strength was greater than that which the spider usually encountered, and a tussle ensued. Now mark what the spider did. Seizing the wasp in the rear, it caused it to rotate as upon an axis of the web in which it was entangled, and at the same time emitting from its abdomen a six-fold strand of web, in a few seconds the unhappy wasp was, by means of the rapid rotation, completely enveloped and in as helpless a condition as a chrysalis in a cocoon. The sight of the unhappy wasp rapidly rotating was indeed strange, and each time that the creature at all attempted to struggle out of the web, a fresh impetus was given to the rotatory movement. When at last the creature was completely subdued, the spider commenced to suck the juices from the wasp's body, and no doubt gloated over the victory it had gained over so formidable an antagonist.

Edward A. Martin, "Ravenswood," Carew-road, Thornton Heath.

A Lobster.

A LOBSTER is, according to Mr. Bertram, a standing romance of the sea; an animal whose clothing is a shell, which it casts away once a year, in order that it may put on a larger suit; an animal whose flesh is in its tail and legs, and whose hair is in the inside of its breast; whose stomach is in its head, and which is changed every year for a new one; the new one beginning its life by devouring the old. An animal which carries its eggs within its body, until they become fruitful, and then carries them outwardly under its tail, an animal which can throw off its legs when they become troublesome, and can in a brief time replace them; lastly, an animal with very sharp eyes placed in movable horns.

Miss Edith F. O'Brien, 45, Fern Grove, Liverpool.

Comparative Anatomy.

THE clumsy, pillar-like fore limb of the elephant, the function of which is to sustain heavy downward pressure, contains, bone for bone, from the shoulder blade to the toes, the same skeletal arrangement, with trifling exceptions, as is exhibited by the prehensile hand and lithe arm used for suspensory purposes by the most agile of apes which swiftly swings itself from bough to bough. The small exceptions are that the elephant lacks the last thumb-bone, and that he differs from the gibbon in that (like man, the gorilla, and the chimpanzee) he has only eight bones of the wrist instead of the nine of the gibbon (and other apes). The corresponding homology of the hind limbs is equally overwhelming in its significance. Comparative anatomy yields countless analogous cases. Yet Cuvier taught Prof. Owen and his other pupils that "answerable parts occurred in the zoological scale because they had to perform similar functions" [for example, the wing of the bat, the flipper of the seal, and the hand of the watchmaker!]; and there still exist anti-evolutionists, who hold to this explanation of the fact of answerable bones occurring in different species.

Francis Ram, 25, Priory-road, South Lambeth.

Why is the Earth a Magnet?

IF we examine the iron core in the centre of an induction coil or "shock machine," we find that it possesses magnetic properties, that it is, in fact, converted into a magnet by the electric current circulating around it. This seems to give a clue to the cause of the earth's magnetism. One source of electricity is the evaporation of water, and this process is always going on in our atmosphere which is heated by the rays of the sun. Successive portions of vapour are being continuously exposed to the sun's rays by the rotation of the earth with its atmosphere, and it seems probable that the electric currents thus generated pass over the earth in a direction from the heated air opposite the sun towards that which is about to be presented to its rays, and is not so highly charged with electricity. These electric currents would then act on the earth in a manner similar to that of the currents passing round the iron core and making a magnet of it.

H. M. Tickell (B.A. Cantab.), Trinity Court, 131, Camberwell-road, S.E.

GLEANINGS OF THE GLOBE.

Oak trees attain the age of a thousand years.

The temperature of the human body is the same in all latitudes.

Every river and lake holds in solution a quantity of saline matter.

A needle will float if carefully placed upon the surface of a basin of water.

A Species of white ant (termes fatalis) produces 86,400 eggs in one day.

A cubic foot of air weighs a little over an ounce. A cubic foot of water weighs a thousand ounces.

Woolen clothes were made an article of commerce in this country in the reign of Julius Cæsar.

Soap bubbles owe their circular form to the equal pressure upon all parts of their surface by the atmosphere.

The peculiar chirping sound made by crickets is caused by the friction of the edges of the hard wing cases with which these insects are provided.

It is calculated that if a perfect system of wires could be provided a despatch might be sent many times round the world during two beats of a clock.

A single spot seen upon the surface of the sun has been estimated to extend over 77,000 miles in diameter, and a cluster of spots have been believed to include an area of 3,780,000 miles.

A Telephonic service will be established next spring between Athens and the Piræus, and the necessary apparatus has already been ordered. The yearly subscription will be 200f. in Athens and 175f. in the Piræus.

Gold is yellow only by reflected light. If a leaf of gold, as ordinarily used by gilders, be placed between two pieces of glass and held up to the light, it will be seen to transmit a brilliant green light.

The movements of air around a burning candle are an excellent exposition of the laws of convection by which the air is kept in motion over the face of the globe, by which winds are created and in consequence of which storms arise.

The discovery of a Frankish Cemetery near the Rhine, has been a serious blow to French pride. Upwards of a hundred skeletons have been disinterred, the average height of the females being close on six feet. The type has evidently sadly degenerated in the last fifteen hundred years.

According to a French statistician, a man of 50 years has slept 6000 days, worked 6500 days, walked 800 days, amused himself 4000 days, was eating 1500 days, was sick 500 days. He ate 17,000 pounds of bread, 16,000 pounds of meat, 4,600 pounds of vegetables, eggs and fish, and drank 7,000 gallons of liquids.

The Astronomer Royal has recently erected at Greenwich a telescope more than twice as large as that formerly used. The optical improvements which are embodied in the new instrument render it one of the three most powerful telescopes in existence. The glass itself has a diameter of 28 inches, and has a focal length of 28 feet. This relatively short distance of the focal plane, it is alleged, specially adapts the objective to photographic requirements.

In the Treasury at Washington the other day the question came up as to the weight of a dollar bill. Scales of perfect accuracy were brought into requisition and the surprising discovery was made that twenty-seven dollar notes weighed exactly as much as a twenty dollar gold piece. The latter just balances 540 grains. However, the bills weighed were perfectly crisp and new. Trial made with soiled notes, such as come in every day for redemption, showed that twenty-seven of them weighed considerably more than the twenty-dollar coin. Every paper dollar on its way through the world continually accumulates dirt, perspiration and grease, so that after a year of use it is perceptibly heavier.

Touching the migrations of the shellfish in connection with the theory of an ancient land-link between Europe and America, Professor Edward Forbes says :—"The student of history follows, with intense interest, the march of the conqueror or the migrations of a nation. The traveller traces, with almost breathless delight, every step of the progress of some mighty hero of ancient days. I have had my share of the pleasure when tracking the course of Alexander and his armies in Pisidia, and determining mile by mile the route of Manlius through Milius—on ground, too, to the modern geographer wholly new. Yet, absurd as it may seem to those who have not thought of such things before, there is a deeper interest in the march of a periwinkle and the progress of a limpet. It is easier to understand how the son of Philip made his way safely through the sea on his famous march from Phaselis than to comprehend how the larva of a Patella crossed the fathomless gulf between Fiumark and Greenland. It is a strong saying, but not said without a meaning, that the existence of Alexander may have been determined by the migration of the shellfish."

A French statistical journal has collected some curious figures relating to railway accidents. The compiler has chosen to limit his investigations to the thirteen years from 1875 to 1888. It appears that railway travelling is safer in France than in any other country in Europe. The French railways carried 2,350,000,000 passengers during the thirteen years at a cost of one killed for every twenty-four millions, and one wounded for every 1,100,000. Moreover, they have shown a very distinct improvement in the last five years, during which the proportion of killed was only one to fifty-four millions, as against one to seventeen millions in the previous eight years. English railways carry a vastly greater number of passengers than French, and show a death roll of 402, as compared with the ninety-three of the French during the thirteen years, while the number of the injured on English railways amounted to 12,372 against 2,136 on the French lines. But the proportion of killed to the total number of passengers on the English lines is one to twenty-one millions, or somewhat less than the French. On the other hand, the proportion of the injured in England is one to 695,000, or considerably greater than the same proportion in France.

HOW TO RESIST COLD.

Why should a community wake up one day with catarrh or with the back of the throat unduly red and the tonsils large? Why, in a particular village or town, shall the medical men be summoned on some particular day to a number of places to visit children with croup? What is the reason that cases of sudden death, by so-called "apoplexy," crowd together into a few hours? Why, in a given day or week, are shoals of the aged swept away, while the young live as before? These are questions which Dr. B. W. Richardson claims, in the *Asclepiad*, curative and preventive medicine have not yet mastered as might be desired. Curative medicine, at the name of them, too often stands abashed, if her interpreter be honest; and preventive medicine says, if her interpreter be honest, "The questions wait as yet for full interpretation."

Still, we are not altogether ignorant; some circumstances appear to be followed by effects so definite, that we may almost consider we have before us, in true position, cause and effect. Let us look at this position in reference to *the simple influence of temperature on the value of life.*

If we observe the fluctuation of the thermometer by the side of the mortality of the nation at large, no calculable relationship seems, at first sight, to be traceable between the one and the other. But if, in connection with the mortality, care be taken to isolate cases, and to divide them into groups according to the ages of those who die, a singular and significant series of facts follow, which show that after a given age a sudden decline of the temperature influences mortality by what may be considered a definite law. The law is, that variations of temperature exert no marked influence on the mortality of the population under the age of thirty years; but after the age of thirty years is reached, a fall of temperature, sufficient to cause an increased number of deaths, acts in a regular manner, as it may be said, in waves or lines of intensity, according to the ages of the people. If we make these lines nine years long, we discover that they double in effect at each successive point. Thus, if the fall in the temperature be sufficient to increase the mortality at the rate of one person of the age of thirty, the increase will run as follows: 1 death at 30 years of age will become 2 deaths at 39 years of age, 4 at 48 years, 8 at 57 years, 16 at 66 years, 32 at 75 years, and 64 at 84 years.

In these calculations nothing seems to be wanting that should render them trustworthy; they resulted from inquiries conducted on the largest scale, and they accord with what we gather from common daily observation. They supply, in a word, the scientific details and refinements of a rough estimate founded on universal experience, and they lead us to think very gravely on many subjects which may not have occurred to us before, and which are as curious as they are important.

We often hear persons who know little about vital phenomena, by which term is meant nothing mysterious, but simply the physics embraced in those phenomena which we connect with form and motion under the term life, harping on the one string, that man knows nothing of the laws of life and death. But what an answer to such presumption do the facts rendered above supply. Life and death are here reduced, on given conditions, to reasonings as clear and positive as are the reasonings on the development of heat by the combustion of fuel. It is not necessary for the vital philosopher to go out into the towns and villages to take a new census of deaths to enable him to give us his readings of the general mortality under the conditions specified. He may sit in his cabinet, and, as he reads his thermometer day by day, predict results. There is a fall of temperature that shall be known by experience to be sufficiently deep and prolonged to cause an increase of one death among those members of the community who have reached thirty years. Then, rising by a definite rule, there have died sixty-four, in proportion to that one, of those who have reached eighty-four years. This is sound calculation, and it leads to reflection. It leads one to ask, what, if the law be so definite, are curative and preventive medicine doing meanwhile, that they shall not disturb it? We fear that they hardly produce perturbations, and we do not see why they should; because, as the truth opens itself to the mind, the tremendous external change in the forces of the universe that leads to the result, is not to be grappled with nor interfered with by an specific method of human invention. The cause is too general, too overwhelming, too grasping. It is like the lightning stroke in its distance from our command; but it is widely spread, not pointed and concentrate; prolonged, not instantaneous; and, by virtue of these properties, is so much the more subtile and devastating.

At first it seems easy to explain the reason why a sudden fall in temperature should lead to an increase in the number of deaths, and it is to be admitted that, to a certain extent, the reason is clear.

Without entering on the question whether heat is the animating principle of all living organism, we may accept that in the evolution of heat in the body we have a measurement of the capacity of the body to sustain motion, which is only another phrase for expressing the resistance of the body to death. For example, if we assume that a healthy man of thirty respires sufficient air per day to produce as much heat as would raise fifty pounds of water at 32° Fahr. to 112° Fahr., and if we assume that a man of sixty in the same temperature is only able to respire so much air as shall cause him to evolve so much heat as would raise forty pounds of water from 32° to 212°, we see a general reason why the older man should feel an effect from a sudden change in the temperature of the air which the younger would not feel; and if we assume, further, that a man of eighty could in the same time produce as much heat as would raise only twenty pounds of water from 32° to 212°, we see a good reason why the oldest should suffer more from a decrease of external temperature than the other two. It is necessary, however, to know more than this general statement of an approximate fact; we ought to understand the method by which the reduction of temperature influences, and the details of the physiological process connected with the phenomena. When a human body is living after the age when the period of its growth is completed and before the period of its decay has commenced, it produces, when it is quite healthy, by its own chemical processes, so much heat or force as shall enable it, within given bounds, (1) to move its own machinery; (2) to call forth, at will, a limited measure of extra force which has been lying latent in its organism; and (3) to supply a fluctuating loss that must be conveyed away by contact with the surrounding air, by the earth, and by other bodies that it may touch, and which are colder than itself. There is thus produced in the body, *applied* force, *reserve* force, and *waste* force, and these distributions of the whole force generated, when correctly applied, maintain the perfect organism in such balance that life is true and steady. So much active force carries with it the power to perform so much labour; so much reserve force carries with it the power to perform a measure of new or extra labour to meet emergencies; so much waste force enables the body to resist the external vicissitudes without trenching on the supply that is always wanted to

keep the heart pulsating, the ehest breathing, the glands seereting or exereting, the digestive apparatus moving, and the brain thinking or absorbing.

Let us, even in the prime of manhood, disturb the distribution of force ever so little, and straightway our life, whieh is the resultant of foree, is disturbed. If we use the aetive foree too long, we become exhausted, and call on the reserve; if we eontinue the proeess, the result is failure more or less perfect, sleep, and, in the end, the last long sleep. Let us, instead of exhausting the force, eut it off at the sourees where it is generated; let us remove the earbon or eoal that should go in as fuel food, and we ereate prostration, and in continuanee a waning animal fire, sleep, and death; or let us, instead of removing or withdrawing the supply of fuel, eut off the supply of air, as by immersion of the body in water, or by making it breathe a vapour that weakens the combination of oxygen with earbon—sueh a vapour as chloroform—and again we produee, at once, prostration, sleep, or death, aeeording to the extent to whieh we have conducted the proeess. Lastly, if instead of using up unduly the aetive and reserve force or of suppressing the evolution of foree by the withdrawl of its sourees, we expose the body to such an external temperature that it is robbed of its heat faster than it ean generate it; if to supply the waste heat we draw upon the aetive and reserve forees, we call forth immediately the same eondition as would follow extreme overexertion, or suppression of the development of foree; we eall forth exhaustion and sleep, and, if we go far enough, death.

We have had in view, in the above deseription, a man in the prime of life, in the eentre of growth, and deeay. In regard to the force of animation in him, let us look at him now retrospectively and prospeetively. In the past his has been a growing, developing body, and in the eourse of development he has produeed an exeess of foree commensurate with the demands of his growth; this has enabled him gradually to bear more fatigue and more exposure, without exhaustion, and even with ease, until he has reached his maximum. When he has stopped in development, when he stands on a fair level with the external forces that are opposed to him, then his own foree, for a short time balanced, soon stands seeond in eommand. He feels eold more tenderly; if his rest be broken, the demand for artifieal heat is more urgent; if he lose or miss food, he sinks quickly; and, returning to our faets, as to the influenee of the external temperature on mortality, these are the reasons why a fall in the thermometer sweeps away our population aeeording to age so ruthlessly and decisively.

If we analyse the facts further by the side of the diseases which kill the old, we find those diseases to be numerous in names, but all of two types. They are diseases whieh of themselves tend either to produee undue loss of force, or that tend to prevent the development of foree at its orgin. Thus affections whieh are aeeompanied with exhaustive loss of fluids from the body, sueh as diabetes, dropsies, and hæmorrhages, are of the first class; affeetions in which due supply of air to the lungs is prevented are of the second elass, espeeially bronehitis, a disease so eommonly assigned as the cause of the deaths among the members of the aged and enfeebled population, that sueeeed immediately on an extreme fall of the thermometer.

(*To be concluded in our next.*)

Most alkaline salts dissolved in sufficient quantity in water act as extinguishers of fire. Sulphate of sodium is excellent. Bicarbonate of ammonium is good, as yielding a certain amount of carbonic acid gas.

HYGIENE FOR THE HOME.

What have we to do in the world but to build up fine homes? If that is done, the rest is done; for a eity or a nation is only an aggregation of homes. Build if possible, on a hillside; not, however at the top of a hill. A site on a hill side will afford protection against wind and weather, and at the same time assist in the matter of draining.

To advoeate sunny rooms and open-light houses and sunbath windows does not require that we should believe in living always in the direet rays of the sun. Both sides must be considered from a rational standpoint. The morning sun should be taken direetly on our bodies; the noonday sun of midsummer should never be endured, if we can avoid it.

Hygiene in architecture means, then, to have if possible an exposure for the morning sun, dry eellars, no dark rooms, or even dark closets, perfeet ventilation and easy staircases. But we do not believe the story, whieh is often told, that in cholera epidemies those fall easy victims who live on the sunless sides of streets, while those who inhabit the sunny side are comparatively exempt. For what is true in eholera must be comparatively true in other epidemies, whieh is unproven. But when we are advised to build roof gardens, no better eounsel could be listened to. Almost every city or suburban house should have a roof garden. The objeet of such gardens is not only to grow flowers and fruits, but to furnish summer arbours of beauty for rest and sleep. There are gardens of this sort where families grow a large proportion of their vegetable luxuries, sueh as lettuce, tomatoes, radishes, and even strawberries. An abundanee of flowers ean also be had. We shall come round after a while to an architecture that makes as much of roofs as of the other floors. There we shall have such opportunities for pure air as nowhere else. But at present quite unlike those who live in Eastern lands, we make no use at all of the roof.

There is one thing speeially to be wondered at, that while those in the eountry are aping city houses as to their exterior, they have done very little to adopt their speeial advantages. The bath room in especial is laeking. There are not ten houses out of one hundred in the eountry supplied with any conveniences for bathing, or with a drainage system. The three requisites to health are generally given as pure air, pure water and pure soil; but to these must be added pure milk. As for air, the average country eellar is as bad as the air of a pest-house. As soon as elosed for winter the house is charged with poisonous effluvia.

Impure water supplies are not as prevalent in the eities as formerly, but in the eountry they are still a terrible souree of danger, although probably more danger lurks in milk than in water. Milking is done very largely by men whose persons are uncleanly, and who have no proper ideas of purity and neatness. But if we can once get it to the house without its being eontaminated, there is no surety that it will remain safe for human use. It is quiek to absorb impurities from the air, and milk forms an admirable breeding plaee for numerous enemies to health. It is certain that many an epidemie of scarlet fever, and probably many a death from typhoid fever, might have been prevented if the eontaminations of milk and their easy transportation from house to house had been elearly understood. Several cases of outbreaks of typhoid fever have within a few years been traeed to the water plaeed in milk by dishonest dealers and taken from polluted wells or streams. The washing of cans even in infeeted water is sufficient to transmit the germs of disease. Scarlet fever is

now, perhaps, the most dreaded foe of our households, and is known to be communicated by means of minute particles of the sloughed-off skin of the patient. These infinitesimal particles are easily taken in by exposed fluids. Cows are also subject to this fever, and so the danger is vastly increased. Diphtheria has also been proved to be carried about in milk, and, last of all, the bacillus tuberculosis of consumption. Many physicians, believe that using milk from cows affected with lung diseases is the cause of a large proportion of the pulmonary disease of human beings. Nothing should be taken for granted less easily than that milk is a safe food. We have seen enough of the pollution, dangerous or otherwise, at least disgusting, connected with ordinary milking by average farm hands, to assure us that it is impossible to be too careful what is bought of this article, and what consumed. In one case, of 1000 quarts carefully examined, two handfuls of solid filth remained after distillation. This danger is by no means confined to city purchasers.

But "pure air, pure water, pure milk" are to be supplemented by pure soil. Now, in time, about any house not provided with careful drainage, the soil becomes completely saturated with poison. And we are bound to say that this is the case with a large proportion of country houses. The best possible manure is the soil about a house, after it has been torn down. The solid waste from a house can be easily disposed of, and largely is so, as food for animals; but the liquid waste is dashed out of doors, or into an open sluggish drain, where it accumulates until it is ready to infect the occupants of the house. A very large part of the waste of houses should at once be buried, especially decaying vegetables, and the dust which is gathered by sweeping. A war on ordinary sweeping should, however, be inaugurated; for, of all dangerous habits, none is worse than that of flinging that combination of everything, which we call dust, into the air to be breathed. Brooms should be abolished. Hard floors, with rugs to be lifted and shaken out of doors, with a compliment of work with the scrubbing-brush, will drive out our present system of carpets and brooms. No one can tell what is or is not in the dust on his floor. A carpet in the course of six months is permeated with organic waste brought in from the streets or breathed off or sloughed off from our bodies. These dangers are even worse in city houses; and the soil of a large city can not become otherwise than permeated with danger.

Sanitary furniture is a new topic, comparatively, but when we consider the known danger from wall-papers, from certain cloths used for cushions and for curtains, and the diseases that may spring from poisonous plants, the subject ought to have strong emphasis. We have heard of one case of desperate poisoning by the volatilising of arsenic from a chair painted with green arsenical paint. The French Government appointed a commission to test the cretons used in house furnishing, and found the browns were often dangerous, even to handle, as well as the greens; while in other colours, also, there was a dangerous quantity of arsenical colouring material. In speaking of dust, we have said enough about our carpets and floor coverings, but not of curtains, which should, as far as possible, be entirely dispensed with. If you wish to know why, you may shake a curtain in any well-ordered house where neatness is the rule, and you will see that, in spite of orderly housekeepers, there is nothing like a curtain to capture dust particles. If shaken every day they still are dust-charged. An old lounge used for years, where there have been sick persons, also, becomes pestiferous. Such articles should, if possible, be covered with leather, or recovered frequently. Better yet, if we were to adopt bamboo furniture and renovate our cushions often and regularly. Wall paper should not only be dispensed with, but plaster as well. All our rooms will in time be wood lined, and either painted or varnished. In this way all possibility of lurking germs of disease, of scarlet fever, diphtheria, and other dangers will be prevented. But apart from dangers, in the long run, wooden walls are least trouble and expense. They may also be made more beautiful.

The most dangerous element of confined house air is not the carbon gases, but the organic matter given off by human beings, either in exhalations from the exterior or from the breath. It is this material, which accumulates with great rapidity, that gives the close odour to churches, school rooms and any other crowded apartment, and creates a depression of spirits and headaches, or nausea. If not directly poisonous, this compound reduces vitality and creates conditions unfavorable to resist the attacks of disease. A mouse placed under a bell-glass, care being taken to supply it with oxygen and to remove carbon gas and watery vapour, allowing only the organic matter to remain, at the end of forty-five minutes, was found dead. That is, we have made a mistake in supposing our worst danger in the air was that which can be removed by vegetation. Plants can not take up the organic waste of our living, although they do absorb large amounts of carbonic gas. The more immediate danger lies in the actual presence of the germ seeds of diseases.

Too much has not been as yet spoken on this subject of family wholesomeness and home hygiene. We trust we shall see the day when it will be taught universally. One-half the deaths that are recorded are already escapable and inexcusable, and yearly we are gaining in our possible mastery of nature. We can afford to turn aside cheerfully from material inventions and make our next age one of contest with disease and victory over death.

SCIENCE MADE POPULAR.

The child is the father of the man, and there is no question that the best method of forming the callow mind is to instil children with useful knowledge in the playroom through the medium of toys and other attractive playthings. The young idea will grasp the alphabet much more quickly if the letters be combined with a puzzle, and so it is with geography and astronomy, mathematics, and other sciences. For this reason we specially congratulate Messrs. George Philip and Son, of 32, Fleet-street, the well-known "popular educators," on the excellence of their latest productions for use in the direction that we have indicated. The productions include a new terrestrial globe. We are quite aware that these instruments are fairly plentiful, but, unfortunately, their price is prohibitive, but Messrs. Philip have now produced a well-finished article for the insignificant sum of five shillings. A revolving "planisphere," with candle arrangement at the back, well bound in leather, is equally good value. An "orrery," arranged for finding the position of various planets for every hour in the year, is an excellent educational arrangement, while a well and neatly constructed "sun dial," for three shillings, to which is fixed a compass, is a most desirable present for a boy or even an adult. We recommend these specialities because we have tested and found them accurate, and consider them desirable for educational and amusement purposes. We are especially glad to see that a terrestrial globe may now be purchased for the price of an ordinary school atlas, the pages of which are so misleading to the youthful mind.

CAN WE MAKE GOLD?

It is always interesting to trace the evolution of a science, and to note its unfolding and progressive development, like the breaking of the morning. The dawn reveals wild shapes and distorted forms, the shadows of sunrise stretch out limitless, but with the onward sweep toward full day, portentous forms and endless shadows settle down to the safe and quiet realities of every-day life. So the wild dreams of the dawn of science have subsided into the assured facts of chemical science. Alchemy is often called the forerunner of chemistry, and out of its broken columns there has been built up the enduring temple of chemical science. No science has a more enduring basis of known facts than chemistry, and none can more calmly examine the basic principles upon which it is built without fear that the foundation stones will turn to dust upon the touch of investigation.

But no science comes to us like Minerva leaping from the brain of Jupiter,—"adult and full armed,"—possibly because Jupiters are so rare, and the bold surgery of Vulcan so seldom invoked. The passage from alchemy to chemistry is full of suggestions, and has often been considered, but usually by contrast rather than comparison. One filled the world with vast hopes but unsatisfied longings; the other has crowned the race with benefactions. Yet the results of the labours and discoveries of the alchemists have been of great value to the world, even though the direct objects they sought forever eluded their grasp and left disappointment and despair to their votaries.

We are prone to look back upon this nebulous science with disdain as the product of an age that had full confidence in magic and sorcery, that could accept without hesitation the elusive nature of matter, yet find no difficulty in the belief in the resistless power of occult forces. But let us be candid even in our review of ancient error. Let us see what were the hopes and aspirations of these hermits of science, and see how modern thought stands related to ancient dreams—whether we find in scientific thought, the same as in matter, a tendency to move in recurring cycles.

The objective points of the alchemists were:

1. *The Elixir of Life*, panacea, all-cure, a substance which would confer quasi-immortality upon any one who should swallow it, curing all sickness, assuaging all pain, and transforming hoary age into blooming youth. It was even more eagerly sought than the transmutation of metals. Life is the highest gift, and without it all other blessings turn to ashes. "All that man hath will he give for his life." But the crowning of life is health. It is not wonderful therefore that men in all ages have sought under various names the elixir of life.

2. *The Alcahest.*—The alchemists searched for some substance that would dissolve all other substances—alcahest, or universal solvent. Crookes forcibly suggests that this is found in fluorine.

3. *The Philosopher's Stone*, having the same purifying and ennobling office for mineral matter that the elixir of life would have on animal forms. By means of this substance they could effect the transmutation of base metals into perfect metals, "curing them of their sickness and perfecting their nature," thus changing copper to gold and lead to silver, performing "the great work" by projection of the philosopher's stone on base metal in presence of great heat.

Such were the dreams, the hopes, and the endeavours of the alchemists—life prolonged at pleasure, health, perennial, wealth beyond measure. It was a great hope, and it was slow to die. The things sought are indissolubly interlinked with the desires if not the expectations of humanity. Nothing debasing entered into this scheme, but rather the aim was to ennoble man and matter, and out of base material to bring forth the flower and fruit of perfection. To a degree, man would become a creator, and a semblance of omnipotence would be placed in the hands of mortals, not merely by linking himself with the powers of nature and clothing himself with their immeasurable might, but by subduing these forces and compelling them to surrender their secrets and do his bidding. By torture nature could be taught to obey, and become the slave of her mortal child, and the crucible became the instrument and symbol of this power.

Consider, also, how slowly the dreams of alchemy have given place to the wide-awake facts of chemistry. The great Napoleon, during his campaign in Egypt, sought initiation into the dark mysteries of Egyptian secret art. Napoleon III., before he ascended the French throne, had in his service those who attempted the transmutation of baser metals into gold. Dumas thought gold might be an allotropic form of copper, and silver allotropic lead: and Sir Humphrey Davy told the elder D'Israeli that he did not consider the undiscovered art of transmutation an impossible thing.

The ancients, arguing from analogy, supposed that metals grew like vegetables, only the growth was subterranean; and there was a vain search for the seeds of metals. Foiled in this quest, they thought that metals passed upward by successive development by a sort of evolution, the base metals being progressively changed to those of a higher order till perfect metal such as gold was formed. A third conception was that metals are composite, made up of some basic matter or earth, and phlogiston (pure fire). The notion of the composite character of a metal was perhaps the most damaging error of the alchemists. With them a metal was not a simple body, but the union of an earth with an inflammable matter: that the metalline character resided in the phlogiston rather than in the earth: that the greater the quantity of phlogiston combined with the earth the more perfect was the metalline character brought out, and if we could combine enough phlogiston with any earthy body we could form metals even of the most perfect character. The perfect metal, gold, was considered to have an oily or unctuous quality, and the fact that oils contained a large amount of phlogiston was considered significant. To secure the oily quality of a perfect metal, oils were favourite sources of phlogiston; and it was claimed that if intractable earths were fused with oil in an accurately closed vessel, perfect metals could be secured. The alchemists reasoned that if phlogiston were accepted as the metalliferous principle, the combination of which with any earth would convert it into a metal, and the escape of which would reduce any metal to an earth, then the transmutation of one metal into another metal would seem no more difficult than the transformation of earths into metals.

The change of a metal into another metal was not a mere theory with the alchemists, they saw repeated proofs of this transmutation. By the purifying influence of fire they made purest silver out of unquestionable lead, and the silver medals attesting this fact which Dr Bolton lately found in Austria were the *ecce signum* of the alchemists. The Chinese still hold that lead kept in fusion for two hundred years becomes silver, and silver similarly treated changes to gold. What the alchemists required was some means to quickly transmute the whole of the lead into silver and prevent the large loss of lead when fire alone was used. The truth wrongly interpreted only led them wildly astray.

The indestructibility of matter, and the possibility of recovering a given substance notwithstanding all its disguises

by combination with other bodies,—the persistence of matter and the immanence of its properties,—were grand discoveries in material science. They marked the transition from alchemy to chemistry. The recognition of the indestructibility of force was the second great step, the crowning discovery of modern physics. In the words of Faraday. "It is the highest law in physical science which our faculties permit us to perceive."

The question has been seriously raised by an eminent American chemist whether gold can be manufactured. On the affirmative side of this question he points to the fact that didymium has been split into two metals, and by recombining these two new metals the old didymium was again formed. He also points out the complex nature of yttrium as shown by Crookes by means of the spectroscope, and then proceeds to say: "These facts, and many others that could be given, make it probable that the so-called chemical elements are not really elements, but compounds, which in time we shall be able to separate into their constituents, and conversely to reproduce by combining other substances. Among the heavy elements—and hence those that would be expected to yield to the searching attacks of the chemist—is gold. It is not improbable that in time it will become possible to make gold in large quantities—an event which would throw it out of use as a standard of value, so far as it derives its own value from its rarity" At first sight this might appear to be a chemical canard, but the writer proceeds to point out the social and financial results of cheapening of gold.

The statement that didymium is a compound metal is of great interest to the chemist. But the fact that the reunion of these metals will form the old metal or alloy is not so surprising, but is what any chemist would expect. But how do such facts show the probability or even possibility of making any given metal out of heterogeneous materials? If the combination of cerium and samarium would form didymium then a plausible case would be made out. But if praseodymium and neodymium are required to make didymium, how are we nearer the manufacture of this last metal by such discovery? We must still have the two new metals to make the old metal. Suppose that gold can be split into two or ten new metals, the reunion of which will form gold, does this bring us one whit nearer the new age of gold? If it takes gold to make gold, what part or lot have baser metals in such transformations?

The trend of recent discoveries is to increase the number of simple or elemetary substances. The simple nature of any substance has only been held provisionally, regarded as elementary until its compound nature is shown by exhibiting the separate elements of which it is composed. The more recondite the appliances for investigation, the more complete the differentiation, of matter, the greater will be the number of elementary substances, and yet we will be as far as ever from the ability to change one metal to another.

The dsicovery of the periodic law of chemical elements was a long stride in scientific progress. It bids fair to be as masterful in chemistry as universal gravitation in astronomy, and a certain analogy may be traced between them. The planets have certain orbits around the sun, and velocities of revolution proportional to their mass. Did position fix their mass, or mass determine their position? By the periodic law, the atom having a certain mass or weight falls into a certain position. Is the mass of an atom determined by its position, and not rather the position determined by its mass? Does the periodic law require us to consider the properties of matter as mathematical functions of numbers, and thus reproduce the Pythagorean philosophy of number and harmony, that "all things are number, and that number is the essence of everything—the elements of numbers are the elements of existence." Or have position and force acquired the properties of matter?

If there was ever a flank movement on Nature by which she has been compelled to surrender a part of her secrets it was the discovery of the spectroscope, "which enables us to peer into the very heart of nature." It is the "Open sesame" of physics and chemistry. If biology could lay its hands on a similar instrument to unlock the secrets of life, what fields of discoveries would unfold before the explorer!

By means of the spectroscope we may question the very elements and submit them to cross-examination in the court of science. Surprising results have thus been reached, but the trend seems to be all in one direction, to show the complex nature of what was supposed to be simple matter, that didymium, e.g., was not a simple body, but contained at least two metals, was twin in more senses than one. It was much the same as Davy's showing that potash was not a simple body, anomalous among chemical substances, but contained a metal, and thus fell into line in chemical combinations. But does the discovery of even a nest full of metals where only yttrium was supposed to be, require the assumption of meta-metals, stuff which has not yet grown to the full measure of a metal; shall we suppose that each *ultissimum elementum* has only one line in the spectrum, and that the spectroscope will yet reveal swarms of meta-metals in the chemical system, just as the telescope calls out the countless stars from the Milky Way?

On the other hand, does the splitting up of the rare metals justify the assumption that the metals most fixed in character, and which show no tendency to split into meta-metals, such as gold and platinum, are compound in constitution and may be compounded out of baser materials? Crookes' suggestion that what comes to us as copper has been shunted on to the wrong track in its passage from aborigiual elemental matter to make gold, holds out small hope to metallic transmutation.

It is claimed that hydrogen and then lithium first appear in the elemental condensation, because with them the diminution of temperature at which elemental dissociation ceases is reached first of all, the heat being still too great for other bodies to exist, even as elements. The heavy metals, such as platinum and gold, with large atomic weight, are formed later in time, because a vast reduction of cosmic heat was necessary before dissoeiation would cease and elemental consociation become possible. Do platinum and gold give indications of a tendency to dissoeiation more marked than that of lithium when questioned by heat, electricity, and chemical action, or even when cross-examined by the spectroscope? Does not gold exhibit an integrity worthy of a noble nature? Does it hold out to alchemy the most distant hint of a multiple nature by means of which she may hope to divide and conquer? The hypothesis of the evolution of the chemical atoms by aggregation or polymerisation of one matter substance challenges scientific thought. Based upon broad assumptions and sustained entirely by analogy, it will hardly disturb the relative coinage value of the metals by holding out hopes of alchemic transmutation. The advice of Mr. Crookes to treat it simply as a provisional hypothesis is conservative and wise.

TO INVENTORS.—Anyone having a good Invention can, on applying to the Editor, "Science Siftings," obtain the advice and assistance of a well-known Patent Expert, free of charge.

PHRENOLOGY EXPLAINED.

By Stackpool E. O'Dell,
Author of "Phrenology: its Truthfulness and Usefulness," "Old St. Margaret's," "Merciful or Merciless?" "Brompton Lectures," "Mental Troubles," etc.
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X.

Dr. Bronssais, Professor of General Pathology to the Faculty of Medicine, Paris, who has delivered many valuable lectures on phrenology in the University of Paris, said in one of his lectures that before he became acquainted with phrenology, he entered into a large music store where there were the portraits of about forty eminent musicians, and that on looking at them he was forcibly struck with the sameness in the formation of their heads, where the organ of tune was localised by the phrenologists. This organ is above that of order at the limit of the insertion of the temporal muscle, it is covered by the crest of the temporal bone. Its action is to take note of what we call airs, it derives pleasure from the harmony of sound, no matter from what source it comes, whether it be vocal or instrumental. This includes voice-tones in conversation, reading, or oratory, as well as singing. In accordance with size, activity, and training, there will be ability in the discerning of musical notes and harmonious sounds, there will likewise and generally—although not of necessity—be ability in the production of harmonious sounds in speaking, reading, singing, or instrumentally. Some people possess this organ so small or inactive that they derive no pleasure whatever from music, be it ever so well performed, although in regard to other matters they may be cultivated and excellent judges. In such people we find this portion of the head small, or the brain will be inactive. Those who possess the organ rather larger will be able to derive pleasure from music while it is performed, then the pleasure and memory of it ceases altogether. We must allow that this is the mental state of not a few. Other possess this mental quality in a still larger degree, and besides receiving pleasure from harmonious sounds, they can recall the pleasurable feelings at will. A higher degree gives ability to reproduce tunes. There are some, who, after listening to one or two musical productions, can reproduce every note. There are others, who, possessed of the highest sensibility to music, can compose or originate. It is not alone that they can do so, but they are almost compelled to do it; they have but little power to restrain the faculty from following its bent. Oftentimes, eminent musicians and composers would like to put this faculty of tune to sleep, but they cannot. During all their waking moments, and not infrequently in their dreams, the rehearsal goes on with a full orchestra. This road, no doubt, leads to madness. In passing, we would like to say, and to impress for practical purposes, that so it is with all dominant organs of the mind. The dominant organ is inclined to work itself up to inflammation and fever heat. This is often the case in regard to tune. Music and madness are often closer allied than we imagine. While the faculty of tune is the foundation of higher class music and composition, many others are auxiliary to it. The kind of music the mind appreciates will be in accordance with the direction the other faculties take; some prefer grave, others gay, some religious, others secular, some classic, others simple and homely compositions. Good composers are scarce, because so many faculties of a first class nature are required to be dominant. Such require minds highly sensitive to beauty in form, shape, colour, and sound, with the imagination largely developed. To attain to this point of musical sensitiveness does not imply happiness. As a class our recognised musicians are not in the enjoyment of that happiness which is of a continual nature, although they may know what the happiness of frenzy is. We should all derive advantage by at least moderately cultivating the organ of tune and trying to appreciate the harmony of sound. Let us commence by expressing our words in a harmonious manner, even in ordinary conversation. Those who speak with harsh and grating accents, might try to soften their tones—what they say will have greater influence.—Some people speak so musically that independently of the matter, it is a pleasure to listen to them. Why should not the voice be as sweet and musical in ordinary speaking, reading, or oratory, as in singing? The influence of some of our best orators is derived from this faculty of tune. The musical sense can be cultivated by all in home life, in conversing and reading as well as in instrumental performances and efforts of a more ambitious nature.

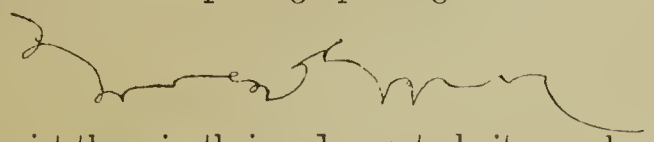
THE VOLCANOES OF THE WORLD.

The number of volcanoes in the world is very much greater than is commonly supposed, there being altogether about 350. Australia has no known volcanoes, but in North America there are 20, in Central America 25, in South America 37, in Asia 24, in Africa 10, making a total of 116 on the continents, the remainder being insular. As a rule, they are not isolated, but are found in systems. One great chain, comprising Vesuvius, Ætna, Stromboli, Vulcano and others, is found in the Mediterranean. Another extends down the West African Coast. The two greatest systems form the eastern and western boundaries of the Pacific, the former extending along the western coast of the Americas, the latter beginning in the peninsula of Kamtchatka, where there are twelve close together, and extending down the coast of Asia and through the South Pacific islands to the antarctic regions. East and west of this great chain extend two branches, the first through the Navigator, Friendly and Elizabeth Islands, the second through Java, Sumatra, the Nicobar and Andaman Islands, almost to the coast of Burmah. The leading volcanic range comprises not only the Kamtchatka and Japanese volcanoes, but four active vents in New Guinea, a number in New Britain, the Solomon Islands and the New Hebrides, several in New Zealand and Mounts Erebus and Terror in the antarctic zone. The American system comprises thirty-one active vents in the Alentian Islands, several in Alaska and British Columbia, and two or three in the United States. Throughout the Rocky Mountains there are frequent evidence of volcanic action in comparatively recent times, and in the Andes hundreds of extinct volcanoes are found. The best-known volcanoes are not the highest. Vesuvius is but 3978 feet above the sea; Hecla, 3970; Stromboli, 3000, while Ætna is 10,874. In contrast with these are Iahama, in Peru, 23,000 feet; Thullaillac, in Chili, 21,000; Arequipa, Peru, 20,500; Cayambi, Ecuador, 19,813: Cotopaxi, 19,500; Mount St. Elias, 17,900; Popocatapeti, 17,884. Twenty-four known volcanoes each exceed 10,000 feet in height. The isolated volcanoes, apparently unconnected with any system, are those of Iceland, a group said to exist in the heart of Siberia, a group mentioned as being located in China, and the Sandwich Island group.

It is a mistake to suppose that any bodies have of themselves a tendency to fly upwards. Even hydrogen gas, the lightest of all known bodies, has weight and would fall to the earth if not surrounded by the denser air.

PHONOGRAPHIC PUZZLE PHRASE.

Those phonographers who believe that any distinctly written shorthand characters may be read by adopting the methods by which ciphers are unravelled, may possibly like to test their patience and skill on the following remarkable combination of phonographic signs :—



To assist them in their arduous task, it may be pointed out that: (1) It is a complete sentence consisting of twelve ordinary English words in constant use ; (2) These words consist of 57 letters, thus giving an average of $4\frac{3}{4}$ letters per word ; (3) A few letters have been omitted to form simple contractions such as are used in longhand, but there are 9 *vowels* expressed, and there are no "grammalogues" used except such as may be said to fall under the definition by having one letter omitted.

These statements will appear so incredible that it may be necessary to say that they have been verified and confirmed by some of the best known professional shorthand writers in the country, including Mr. T. R. Wright (S.W. to the Society of Arts, Pharmaceutical Society, etc.), Mr. T. Meredith (S.W. to H.M. Patent Office), Mr. George Walpole (Editor of Hansard's Parliamentary Debates), and several other members of the Institute of Shorthand Writers, to whom the key has been divulged. These experts have acknowledged that the shorthand is exceedingly legible, and they have been unable to suggest a possible misreading of a single word in the sentence.

Brief as the above outline is, every experienced phonographer could easily make it shorter without in the least impairing its legibility. It is not intended to show how the words *should* be written, but merely how they *could* be written in case of necessity when following a very fast speaker, and as a refutation of the criticism that the author of the system in which it is written had achieved legibility by sacrificing the ability to phrase or join words together readily.

On account of the prominence given to the vowels in this system, and the ingenious way in which they are made to express not merely vocal sounds, but also the same sounds joined to consonants by one stroke of the pen, the author (Mr. J. Fielding, of Bromley, Kent) has given it the title of "vocal shorthand." He strongly recommends those who learn it to commence with the vowels first, and then add on one or two consonants at a time. They will thus be able to write words and sentences from the very commencement.

Mr. Fielding does not make any extravagant claims for his system, but it is the opinion of many well qualified to judge that he has accomplished what has hitherto been considered impossible, viz., the production of a simple system of shorthand in which the vowels may be written in their natural order, without sacrificing the extreme brevity of outline, which is absolutely essential for rapid verbatim notetaking.

We may mention that Mr. Fielding is a practical expert. He is the gentleman who, entirely unaided, accomplished the remarkable feat of placing in Mr. Curwen's hands a verbatim report of an Exeter Hall May Meeting (1882) before six o'clock the following morning. This report filled ten columns of the *Tonic Sol-fa Reporter*, and contained a portion of a hymn sung in the Malagascy language by a returned missionary.

LIVING WITHOUT EYES.

There are many animals in the world which pass all their lives in darkness, never seeing a ray of light. Every one has heard of the blind fishes of the Mammoth Cave. This cave is the biggest of 500 great caverns in the United States. All of them are inhabited by numerous other sorts of creatures that have no eyes for vision. Literally speaking, there is no such thing as a blind fish, since the most sightless of the finny tribe possesses visual organs in a rudimentary condition ; but through want of use, the optic ganglia and nerves have broken down and been absorbed.

Among the animals in these caves where Egyptian darkness ever dwells are blind crayfish, colourless, which in the water by torchlight look like white phantoms of their outdoor kind. Now and then in such places one comes across a common frog, emaciated and seemingly discouraged, which has found its way, how no one knows, to the Tartarean realms. Also, one discovers curious cave rats of the same colour as domestic rats, but with longer bodies, like a weasel's, more developed whiskers and much bigger ears.

Of bats there are multitudes in the caverns, as one might expect, inasmuch as they are creatures of darkness. Countless numbers of them frequent the black hollow of Mammoth and Luray. There were times in the past when these vast caves were the resorts of gigantic beasts, such as the megatherium, mylodon, magalonyx and other huge sloths wiped out by the glacial epoch. With the bones are found those of extinct tapirs and peccaries.

Spiders of several kinds are found in the caves, They are uniformly small, weak and of sedentary habits. No webs do they spin, save a few irregular threads sometimes. What they live upon is rather a puzzle, though it is supposed that they catch stray mites and other such small fry. Scavengers constitute a large part of population of the caverns. Carnivorous beetles are plentiful, particularly in those places where parties take lunch.

Such rejectamenta of tourists accumulate in spots in the Mammoth Cave actually by cart loads ; but though there is so much moisture, decomposition progresses so slowly that the offal is not offensive. The processes of decay seem to be accomplished chiefly by a low fungi. It is said that meat hung up at the mouth of these caverns remains fresh for a long time, and it is surmised that the bacteria which cause things to become putrid are probably rare in the underground atmosphere.

No animals whatever are found in the dry parts of the caves. Dampness, or a certain degree of moisture, seems to be essential to their existence. Under the stones one finds white, eyeless worms, and in the damp soil around about are to be discovered blind beetles in little holes which they excavate and insects of the thousand-leg sort. These thousand-leg insects, which in the upper world devour fragments of dead leaves and other vegetable debris, sustain life in the caverns by feeding upon decayed woods, fungus growths and bat's dung. Kneeling in a beaten path one can see numbers of them gathered about hardened drips of tallow from tourists' candles. There are plenty of crickets, also.

So far as the insects of the caves are concerned, the loss of sight which they gradually undergo is sufficiently well understood. The first step is a decrease in the number of the facets which make up the compound eyes, with a corresponding diminishment of the lenses and retinæ. After four or five generations the eyes become useless. It would be most interesting to breed these or other blind creatures of the caves in the light, so as to find out if they would get their sight back.

In all animals, including man, it is found that nature tries to compensate for loss of vision by increasing the power of the sense of touch. Thus the antennæ of cave insects grow remarkably long. It is very curious to find that nothing in their behaviour suggests the fact that they are blind. They walk, run, stop, explore the ground and try to escape from the grasp of the specimen-hunter just as if they really saw. The light of a candle startles them as much as if they perceived it visually.

It is a remarkable fact, proving that the ancestors of these creatures could see, that in the embryo stage of their existence they have eyes well developed.

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SCIENCE NEWS AND NOTES.

"No science is speedily learned by the nob'est genius without tuition."—WATTS.

Dust and Dusting

was a topic discussed seriously in these columns a fortnight ago. We received no less than one hundred and twenty-two letters from indignant housekeepers inquiring how we could devote so much valuable space to so trivial a subject. "It is our littleness that sees no greatness in a trifle." We are glad, therefore, to find that our opinions are backed by no less an authority than our great contemporary, the *Lancet*. Different observers, this medical authority points out, have from time to time described the components of ordinary dust, and these, it is needless to say, exhibit special characters in almost endless variety. Mineral matters, animal and vegetable débris, morbid germs—whatever, in fact, is light enough and small enough to remain for a time suspended in air, comes under this common and generic but far from harmless term, The spread of cholera and exanthematous (eruptive) diseases has, no doubt with perfect truth, been attributed to its influence. It is clear, then, that the method to be employed for its removal is a matter of some importance. As regards this, we need hardly discuss every suggestion of housewifery.

Some pin their Faith,

not without reason, to the damp duster rather than the dry one, but this will not suffice in itself, and, moreover, every kind of furniture does not bear such treatment. Where possible, of course, it is of the two the more effectual plan. Above all, however, it is needful to remember that the object aimed at is not displacement of dust only, but its removal, and for this purpose a combination of thorough daily ventilation by open doors and windows, with careful sweeping, followed by at least displacement of any dust still remaining with a cloth, is the only method alike feasible and effective. All overcrowding with furniture or with woven fabrics is to be avoided. Bed curtains and vallances are no less objectionable, and bare floors are more wholesome than the choicest carpet. Nowhere is care in these particulars more justified or more imperative than in the crowded homes of the poor. Let us but mention one other point—the healthy effect of sunlight. It is now admitted that some disease germs lose their power on exposure to light. In this fact, says the *Lancet*, we have a standing protest against the custom of darkening rooms with lowered blinds, or that æsthetic error which covers the window space with crossed curtains.

The Effectual and Speedy Cure of Influenza

has been treated in a very interesting fashion by Mr. John Crerar, M.R.C.P. This gentleman has formed a new theory of the treatment of acute infective diseases, based on "the analogy of nature," whereby is meant such an inference, for example, that the earth is globular from observation of the uniform shape of the other heavenly bodies. Applying this to the study of micro-organisms he infers that their life and reproductive activity depend upon their inhabiting suitable nutrient media under fit conditions.

A Cubic Centimetre of Beef Tea,

Klein tells us, kept in an incubator at a temperature of 98° F., and peopled by bacilli, multiplies its population 80,000 times in the first twenty-four hours, 450 times in the second twenty-four hours, and only five times in the third twenty-four hours. We thus find that, as the food supply becomes diminished, and the peculiar product of the fermentative process increased, the reproduction gradually declines and ultimately disappears. During the process of reproduction and growth of a micro-organism there is a peculiar substance excreted or formed which is baneful to its own microbe, and as this substance increases in quantity it diminishes the vitality of the microbe, and when it reaches a certain proportion it destroys the life of its microbe. This is proved in many ways. Now, according to Dr. Crerar, the application of this fact to the treatment of infective diseases consists in bringing about in the system a change in the environment of the microbes analogous to that which is spontaneously effected by their own activity, since they apparently excrete products which in sufficient quantity are

inimical to their own existence. Hence the possibility of a disease exhausting itself, as it were, without any treatment, provided that the vital powers of the patient can resist the poison more than the microbe that produces it.

The State of the Body must be Altered

so as to make it intolerable to the minute invaders. We then secure a valuable truce and gain time to allow the organism to build up a vitality high enough to get beyond the reach of our remorseless foe, and thus the patient may be saved. Hitherto the search for such a desirable agent has been chiefly carried on in connection with the cultivation and study of the disease-generating microbe. Dr. Crerar proposes to look for a similar subject in connection with the changes which invariably take place in the system of the patient during the acute stage of the disease, in fact, to transfer a baneful and death-producing plant—the pathogenic or disease-generating fungus—from its congenial soil and climate in the tropics to the uncongenial soil and climate of the Poles; and he confidently expects that, in its new situation, it will not long retain its power to do harm. Dr. Crerar, applied this theory to the treatment of influenza with the happiest results. In the epidemic of 1889–90, he was face to face with an extreme case of this disease, when it was quite clear to him that something more than treatment upon general principles was necessary if he wished to save his patient.

A Process of Reasoning

similar to that which we have endeavoured to explain, occurred to Dr. Crerar at this juncture. Acting promptly on the indication to which it pointed, he artificially altered the prevailing state of the patient, with the result that the disease very speedily disappeared. He subsequently repeated this new line of treatment in hundreds of cases, with the same fortunate result. In influenza the patient is usually found with a flushed, woe-begone face; intense frontal headache; increased temperature, at the same time perhaps that he is complaining of cold or shivering; a quick pulse, great prostration, and unspeakable distress. When Dr. Crerar finds a patient in this state he prescribes, and when he visits him next day he finds all the acute symptoms gone; no distress, pulse and temperature normal, and the patient comfortable, but weak. On inquiry, he declares, in nineteen cases out of twenty, that the relief was obtained after the second dose of the medicine—that is, within four or six hours after the commencement of the treatment.

The Treatment Consists

in "increased alkalinity," by means of bicarbonate of potash, which Dr. Crerar considers the most effective antagonism. He prescribes thirty grains in a teacupful of milk every two or three hours, with a few drops of the tincture of capsicum, but this is not at all essential. This prescription has, however, certain drawbacks, which in their turn are easily combated if properly treated. For this reason we strongly counsel our readers only to use this cure under medical advice. In fact, we trust all our friends possess sufficient common sense not to attempt doctoring themselves.

The Auburn Hair

so fashionable at the moment, is not a modern craze, and is only another instance of history repeating itself. The famous golden-haired beauties depicted on the canvas of Titian and other painters of his age were not natural. Before art had changed the colour of their locks they were raven-haired as women of Italy usually are; but auburn or gold was the fashion, and the method pursued to convert a brunette into a blonde was both tedious and painful.

Powders and Lotions

are used nowadays for changing the colour of the hair, but in the days of Titian, the Italian lady who desired to change the colour of her locks, first placed upon her head an enormous hat with an exceedingly wide brim, but destitute of crown. Through the hole at the top her hair was drawn and then spread equally over the edge of the brim. The victim then took a seat in the sun, and for hours at a time remained thus, her attendant meanwhile moistening the hair every few minutes with a preparation of honey, sulphur, and vinegar. This cosmetic, together with the heat of the sun, in a few days effected the desired result and produced one of the yellowish-red coiffures which Titian so delighted to paint. The fact that the blondes were manufactured may easily be surmised from the paintings themselves, for while the hair is yellow the eyes are black, as also are the brows and lashes, and the complexion usually very dark.

An Interesting Anecdote

about phrenology is contributed to our columns by a correspondent, who tells us that when his father-in-law (who at the time of his death was the leading medical man in Plymouth), was a medical student at "Guy's," he was asked to breakfast with Sir Astley Cooper, and there met Spurtzheim, the great phrenologist. The conversation turned on his book that had just been published. Sir Astley Cooper said he had read it, but noticed one great omission, viz., that the bump of common sense was not spoken of. Spurtzheim answered there was no need of it: to which Sir Astley replied, "Surely you admit there is such a gift?" "Yes," said Spurtzheim, "but no need of a special bump; it is the proper balance of all the others."

The Earth and the Moon

may, it seems probable, in the course of events, become more intimately acquainted. A few years ago scientists held the theory that the moon was a dead planet, without atmosphere, and consequently uninhabited. This theory has recently been entirely controverted. The work begun by Prof. Holden at the Lick Observatory upon Mount Hamilton (U.S.A.) has been steadily continued, and the photographs taken by him and his assistants have revealed certain facts hitherto unknown. Photographic observations show a perfect map of the moon, and upon the summit of one of the highest mountains is a white spot which has the appearance of a glacier, proving the presence of atmosphere and making the theory of the habitableness of the moon tenable. It is claimed by Prof. Holden that by a continuous series of photographs he is able to detect any changes upon the surface of the moon, and that a building 50 feet in height would cast an appreciable shadow. If the moon is inhabited, the fact will certainly be discovered sooner or later, but the question of the establishment of communication is still unsolved, although in the face of the scientific achievements of the last century we will not predict that it is unsolvable.

A Curious Plant,

known as the "Water Fairy Flower," is being sold in London by the well-known Covent Garden dealers, Barr and Son. It is the sacred flower of China and Japan, and is called in these countries the "Jos flower," or "Flower of the Gods." It appears to be a species of polyanthus narcissus. The flowers are white with yellow cup, and very fragrant. The peculiarity of the plant is that it is grown in bowls filled

simply with pebbles and water, and some have been known to attain twenty inches in forty days. The Chinese enter into friendly rivalry over the speed and size to which they can cultivate their sacred flowers.

Do Animals Reason?

is a question we have already discussed in these columns. Mr. J. Stopherd, of Bradford, now draws our attention to the fact that Mr. J. G. Romanes in his work on "Animal Intelligence," says that instinctive actions are those which, owing to their frequent repetition, become so habitual in the course of generations that all the individuals of the same species perform the same action under the stimulus supplied by the same circumstances. Rational actions, on the other hand, are actions which are required to meet circumstances of comparatively rare occurrence in the life history of the species, and which therefore can only be performed by an intentional method of adaptation. Reason, therefore, is the faculty which is employed in the intentional adaptation of means to ends. Sir B. Brodie in his "Psychological Researches" defines instinct as "the principle by which animals are induced, independent of experience and reasoning, to the performance of certain voluntary acts, which are necessary to their preservation as individuals, or to the continuance of the species." Reason may also be defined as that power or faculty by which inferences are drawn from facts. There are, Mr. Stopherd tells us, those who contend that thinking carried on without language is instinct, and that thinking aided by language is reason. Abstract ideas are sometimes said to be essential to reasoning; but in an article on "Animal Intelligence," which appeared some time ago in the *Nineteenth Century*, abstract ideas are divided into two classes:—1. Those which are simple enough to be evolved without the aid of language, and (2) those which are so elaborate as to require its assistance. It is in the first-class that animals are generally placed as reasoners. It would seem that Professor Garner claims to have discovered the language of monkeys; and it is by no means certain that other animals are not possessed of languages common to their species. It is, however, beyond question that the mental powers of dogs and other animals are capable of considerable development by training, and that when progress has been made by an animal its offspring frequently inherit tendencies in the same direction.

Cyclonic Disturbances

have recently formed the subject of careful study by M. Le Goarant de Tromelin. He concludes that cyclones originate in the zones where the trade winds of the opposite hemisphere penetrate; and they are caused by an atmospheric increase proceeding from the other hemisphere in consequence of the unequal division of the normal limits of circulation; and that they are determined by the resistance thus offered to the trade winds or the monsoon in following the movement of the sun.

The Measuring of the Aurora's Height

was recently accomplished at Goathabb by M. Adam Paulsen. With two theodolites four miles apart, the height of different auroræ was found to range from one-third of a mile to nearly forty miles. Near Cape Farewell, with a base line of about three-fourths of a mile, the results showed them to range in height from one to ten miles, and at Spitzbergen, with a base line of about one-third of a mile, they were shown to be from 300 yards to eighteen miles high, according to brilliancy. M. Paulsen infers that the aurora only appears at a considerable height in the temperate zone, while in the auroral zone proper the phenomenon is generally produced in the lower atmosphere.

Soap Eaters

are often found among such races as Greenlanders or Laplanders, but then the appetites of these people are so fantastic in other respects, that one or more curious extra articles of diet fails to elicit much surprise. The following extraordinary case of a mania for soap eating which deserves the coinage of the word sapessomania is sent in by a medical correspondent: "Mrs. J————, aged 29, consults me in reference to an irritable stomach of longstanding. She gives the following details: when about 3 years of age she first enjoyed a mouthful of bar soap; so agreeable was the taste that she would eat it "when ever she could get it." When aged 5 years her mother found her spoon in hand, eating soft soap with keen relish. As she grew in years so did her yearning for soap—her playmates ate candy, but she preferred soap; her father brought home to the other children sweetmeats; but to equally satisfy her a piece of common bar soap must be given. Until she was 11 her sapessomania continued. When awake she loved to smell it, handle it, and eat of it. When asleep she dreamed of soap. Often to pacify her a piece of soap was given to her to hold in her hand to soothe her in her sleep, when she continued in her imagination still to eat soap. At 11 her stomach burned her so that she stopped her habit, but still continued to love to handle and to think of eating the great delicacy. When 23, or twelve years after her last feast, an advertising agent left at the door a bar of bathroom soap, which pleased her so much that she ate it all in twenty-four hours. Since then she has eaten none, though there is always the desire to do so. To-day, did not her stomach forbid, the yearning to "eat some more," would be irresistable. Though she can no longer eat it, she still loves to handle it, she loves to use plenty of it in her housework and in her bath room. The smell of it is still sweet to her nostrils, and the thick suds she delights in, remind her of the days gone by, never to return. Strange to say she cares only for the coarse bar soap; fancy soap she never uses. Personally she is of nervous temperament, yet evidently a woman of much self-control. She asserts that her mania is as strong to-day as it was years ago, though she has tasted soap but once in eighteen years. Despite her statements, however, I believe she is still eating the little amount of soap which her irritable stomach will allow her."

Death in the Thimble.

is not so impossible as would at first appear. An instance recently occurred which came under the observation of the *Lancet*. In the case referred to the sufferer was a seamstress, and the mischief resulted from her using a dirty metal thimble marked with verdigris, a little of which appears to have entered a scratch on the thimble finger. We can well believe that this accident was not the first of its kind. Verdigris, it is true, is a mere metallic irritant, and not comparable in virulence to most living germs of disease. It is quite enough, notwithstanding, to excite local inflammation, which friction, contact with dyed cloth material, or the entrance of dirt in any form would quickly convert into a dangerous and general disorder. There is really no excuse for women who trust their fingers in these cheap and worse than useless articles. Steel thimbles are much safer and cost very little. Another variety also in common use is enamelled within, and is, if possible, even freer from objection. Let us not forget to add a caution that cuts or scratches on the hand

should never be neglected by sewing women so long as dyes continue to be used in cloth manufacture.

Palpitation of the Heart.

is one of the distressing symptoms due to dyspepsia and is often caused by excessive mental or physical exertion. Sir Walter Scott was much subject to it. In his private journal, written in 1826, he says: "What a detestable feeling this fluttering of the heart is! I know it is nothing organic, and that it is entirely nervous; but the sickening effects of it are dispiriting to a degree. Is it the body brings it on the mind, or the mind that inflicts it upon the body? I cannot tell; but it is a severe price to pay for the 'Fata Morgana' with which fancy amuses men of warm imagination. In the country I drive it away by exercise. I wish I had been a mechanic, a turning lathe, or a chest of tools would have been a godsend; for thought makes the access of melancholy rather worse than better. I have it seldom, thank God, and, I believe, lightly, in comparison with others."

Mimicry in a Spider

is a power of which few people are aware, but an interesting instance has been observed in the south of France. To snare its prey the spider hides in convolvulus flowers, which are plentiful in this region, and are of three principal colours. A green variety of the spider visits the flowers of a greenish hue, a variety mostly white lives in the white flowers, and a partly pink variety frequents the pink flowers. If the animal is found in a red dahlia it is red instead of pink, and is yellow in a yellow flower. The three varieties were at first supposed to be permanent, but it has been accidently discovered that the colour of any one of these spiders changes in a few days when the insect is placed in a differently coloured flower, and in a box together the pink, white, green and yellow varieties soon become nearly white.

Countries Without Clocks

are few and far between, but Liberia happens to be one of the exceptions. Explorer Buttikoffer says that a clock is rarely seen in the farmhouses of Liberia, and many of the town residents have no timepiece of any sort. He adds that there are few civilised countries where a timepiece can be dispensed with so conveniently. The sun rises at 6 a.m. and sets at 6 p.m. almost to the minute the year round, and at noon it is vertically overhead. Many of the people become so expert in telling time by the sun that they are rarely more than a quarter of an hour out of the way. In place of alarm clocks they depend upon the crowing chanticleer to arouse them in the morning.

Leap Year

occurs, as is generally known, when the year to be ascertained is divisible by four without a remainder. The year 1900 will, however, be an exception of this rule, as when Julius Cæsar reformed the calendar he made the year consist of 365¼ days, which put a leap year into every fourth year. It was subsequently found that there was an error in this calculation, and this error, in the sixteenth century, amounted to a difference of about fourteen days between the civil year and the solar or true year. Pope Gregory XIII., under whose direction the mistake was corrected, ordered, in 1582, that ten days be dropped from the calendar, which restored the vernal equinox to March 21, where it was at the time of the Council of Nice, in A.D. 325, or about three and three-quarter centuries after Cæsar's death. Then, to avoid the error in the earlier calendar, it was arranged that the century years should not be leap years unless they could be divided evenly by four after dropping the two ciphers. This is why February in 1700 and 1800 did not contain twenty-nine days, and why it will not contain that number in 1900, although that date comes four years after and four years before a leap year. There is a slight error in the Gregorian calendar, but as it will amount to only one day in 3,325 years, it is not of much importance to the world yet.

The Forces of the Human Breath

may be practically demonstrated by the following experiment: Take a large bag of good heavy paper, lay it on the table and cover the closed end of it with several books—a Webster, unabridged, and a family Bible, for instance—then blow into the bag, filling or inflating it with air, and you will soon see that it will overthrow the books—*i.e.*, remove a small mountain.

Telegraphy

is only a modern invention as far as the application of electricity to the work is concerned. A method practised by ancient Greeks and Romans consisted in placing in pots, straws or twigs, saturated with oil. They were placed in rows and expressed certain letters according to the order in which they were lighted. Another method was that invented by a Grecian general who flourished in the time of Aristotle, intended for communication between the generals of an army. It consisted of two exactly similar earthen vessels filled with water, each provided with a cock that would discharge an equal quantity of water in a given time, so that the whole or any part of the contents would escape in precisely the same period from both vessels. On the surface of each floated a piece of cork supporting an upright, marked off into divisions, each division, having a certain sentence inscribed upon it. One of the vessels was placed at each station, and when either party desired to communicate, he lighted a torch which he held aloft until the other did the same as a sign that he was all attention. On the sender of the message lowering or extinguishing his torch, each party immediately opened the cock of his vessel, and so left it until the sender relighted his torch, when it was at once closed. The receiver then read the sentence on the division of the upright that was level with the mouth of the vessel, and which if everything had been executed with exactness, corresponded with that of the sender and so conveyed the desired information.

Small Headed People

have reason to be grateful to Professor Virchow, the eminent German scientist, for relieving them from an unflattering stigma. There has always been a popular belief that the size of the brain is in proportion to that of the skull, and that large-headed people are, therefore, endowed with a greater amount of intellectual apparatus than those whose heads are small. Professor Virchow disposes of this theory by pointing out that the Greeks, one of the most intellectual of nations, are also one of the smallest-headed of races.

Cancer and Bad Drainage

often go hand in hand. Mr. Alfred Haviland has made a map of England showing the distribution of cancer, from which it appears that the disease is almost confined to low-lying districts which are often flooded and in which the soil is never well drained, and is almost wholly absent from high and dry localities.

THE PRIZE SCIENCE SIFTING.

One Guinea will be paid each week to the contributor of the most interesting or curious Science paragraph.

The paragraph must not exceed 200 words, and need not be original, but in this case, the source from whence it is copied must be given. All paragraphs must reach us on Monday, and be marked "Prize Science Sifting" on the envelope, unless a postcard be used. Only one paragraph may be sent in by each competitor.

The Editor reserves the right of publishing any paragraphs sent in.

We have awarded the prize of One Guinea to Mr. VAUGHAN TUDOR, 37, Ashmore-road, W., for the leading "Science Sifting." The other siftings published all deserve honourable mention.

The Barking of Dogs.

Dogs do not bark naturally. It is a habit cultivated from their intercourse with human beings. Barking comes with the civilisation of dogs. Originally while still a rude and savage beast, existing in a state of ignoranee and barbarity, a dog never barked. He could not do it, if he tried, because he had not received the necessary preliminary instruction. Barking is not a natural gift, but an art that requires teaching, hard study and acute observation. As an uncivilised wild animal a dog makes a sort of whining, growling noise that is entirely different from the intelligible expressive and, at times, rather explosive barking of a domesticated one. Travellers, during their explorations in different parts of the world, have frequently come across dogs that were not in possession of this faculty of communication. Columbus, on his voyage of discovery of America, took with him a few dogs, which he left behind there, and on his second visit, being some years after, he noticed that they all had lost their propensity to barking.

The Cause of Fatigue.

It is not commonly known that the fatigue felt after muscular exertion is chiefly due to the formation, within the muscles themselves, of certain nitrogenous poisons which are the result of chemical action going on, and which have a paralysing action on the muscle fibres. These poisons are formed by the breaking up of certain reserve materials which exist in the muscles, without actually forming an essential portion of them. When these reserved materials are thus split up, they give out energy which may be available as a source of heat, or as a cause of motion. They accumulate in the tissues of persons who live sedentary lives, and when such people take much exercise they are very liable to an attack of gout or to feverish prostration; owing to the sudden accumulation, within the blood, of too many waste products for the kidneys to remove at once. The immunity from fatigue possessed by those who are continually exercising, is due to the fact that these reserved materials have been gradually removed during the course of training, and little remains capable of producing gouty poisons when much exercise is taken.

Ralph M. Archer, "St. Helens," Demmington Park-road, W. [Hampstead.

Indestructibility of Matter.

We have all heard that matter and energy are alike indestructible, but have we considered fully what this means? It means that every atom of matter in the world has existed as long as time, that every atom of carbon, oxygen, and hydrogen of which your body is composed has always existed in some form or other, perhaps in another person's body, and moreover, will continue to exist, and that energy has existed likewise, whether it be in the form of heat, light, electricity or any other form. Let us follow an atom of carbon in a plant. In it a certain amount of energy is conserved; now, if it be burnt, this carbon is converted to carbonic acid gas, and at the same time the energy is given out in the form of heat and light; that molecule of gas wanders about and is absorbed by another plant, let us say, and the same amount of heat and light is absorbed as was given out in the combustion of that atom, so that we have a kind of perpetual motion,

Francis Carr, "Meaburne," Warham-road, Croydon.

Flesh-Eating Plants.

It is both curious and interesting to note how nearly the animal and vegetable kingdoms merge into one another. The higher forms of plant life possessing organs which perform functions that we are accustomed to consider as belonging only to animals. Some plants possess the unplant-like faculty of flesh-eating. These are generally water or pitcher plants. Of the former Utricularia is an example. This plant has special bladders in which it catches and afterwards absorbs insects. Then there is the famous American flower, the Venus fly-trap, which actually swallows insects in the extreme lobes of its radical leaves. But more remarkable still are the water-pitchers, Drosera and Dioneæ. These curious plants are furnished with hairs or tentacles possessing such an extreme irritability that the slightest pressure of an insect causes them to move and the creature is entrapped. It is then covered with a peculiar secretion containing acid, with the aid of which it is able to perform a process of digestion closely allied to that which takes place in the stomach of an animal. Darwin discovered that this process was followed by another of absorption caused by the small rounded masses of protoplasm continually changing position.

Miss Lottie M. Clarke, Laver-wick, Colchester.

Immortality of the Protozoa.

Natural death occurs only among multicellular organisms, the single-celled forms escape it. There is no end to their development which can be likened to death, nor is the rise of new individuals associated with the death of the old. In the division the two portions are equal, neither is the older nor the younger. Thus there arises an unending series of individuals, each as old as the species itself, each with the power of living on indefinitely, ever dividing but never dying. Ray Lankester puts the matter tersely, "It results from the constitution of the protozoon body as a single cell, and its method of multiplication of fission, that death has no place as a natural recurrent phenomenon among these organisms."

John Coop, 44, Church-street, Adlington, Lancaster,

An Experiment Worth Trying.

It may not be generally known that it is impossible to stand a quart of water dropped into the open hand, drop by drop, from a height of about 3 feet. Before 500 drops have fallen into the hand, the pain will be so intense as to damp the courage of the most hazardous. After a little water has fallen, each drop seems to crush the hand, and a blister in the centre of it is invariably the result.

A. Ingram, 92, Frederick-street, N.

GLEANINGS OF THE GLOBE.

It is stated that steel rails expand and contract one part in each 148,000 parts with each degree of temperature.

An incandescent lamp without a filament is the next event in an electrical way which the public may expect to see.

In average condition a turnip seed may increase its own weight fifteen times in a minute.

The saltest piece of water upon earth is Lake Urumiah, Persia, more than 4000 feet above the sea level. It is very shallow, and no living thing can exist in it.

Mail matter dropped in a box in Paris is delivered in Berlin within an hour and a half, and sometimes within thirty-five minutes. It is sent by means of pneumatic tubes.

Sir Daniel Wilson, supports the theory, now gaining ground, that right or left-handedness is attributable to a superiority in development of the left or right hemisphere of the brain respectively.

Platinum and palladium crystals may be made by placing topaz dust on a ribbon of the metal heated to a white heat by an electric current, the crystals appearing on the topaz.

The tea plant when raised from seed produces a small crop in three years, but it takes six years to come to maturity. The plants live to the age of 40 or 50 years.

A calculation upon the sale of soap in India shows that the yearly average consumed by each person is much less than one ounce.

Nine hundred and fifty submarine telegraph cables are now in operation, most of them in Europe; their total length is over 89,000 miles.

A grain of fine sand would cover 100 of the minute scales of the human skin, and yet each of these scales in turn covers from 300 to 500 pores.

The apparent flattening of the vault of the heavens has been found to have an annual period, and to depend on clouds. It seems least flat with a misty horizon, and less by night than by day.

The three tallest trees in the world are believed to be asequoia near Stockton, Cal., (U.S.A.) which is 325 ft. high, and two eucalyptus trees in Victoria, Australia, estimated to be 435 and 450ft., respectively.

Ericsson's destroyer, to which the great inventor devoted his best years, is of iron, 130 feet long, 17 feet beam and 11 feet deep. Its submarine gun fires from the bow to a 1,000-feet range.

The law of evolution works in language as well as in other things. Twenty thousand words have been added to the English language in the department of biology alone, since Darwin's discoveries.

Herr Geheimrath Auwers, under whose directions the calculations resulting from the latest observations of the passage of Venus across the sun have been carried on, now gives (as the result of these calculations) the distance of the sun from the earth as 92,050,286 miles.

The following method of making paper transparent for copying drawings has been found very serviceable: Place a blank sheet of paper over the drawing and rub it lightly with pure benzine. The tracing can then be readily made, and the benzine, upon evaporating, leaves the paper as opaque as before.

In the last two years in New London (Conn, U.S.A.) the lobstermen have bagged in their deep-water traps not less than five or six indigo lobsters, which are so rare that it is not known that more than two of the kind have ever been taken in the world before. In the same time two blue lobsters were caught by Maine fishermen. Blue lobsters are as blue as the summer sky and extremely beautiful.

Some rare metals, possessing special qualities, are required for certain work. Thus palladium is used in making some parts of time-pieces, and iridium for the points of gold pens. Lithium is the lightest of metals. Rhodium is extremely hard and brittle, and is only fusible at a very high temperature, and iridium is the heaviest substance hitherto discovered. The uninitiated have no idea of the value of these scarce products, which are most of them far more precious than gold and silver.

A statistician says:—"Few are aware of the vast number of people that can be placed on a small tract of ground. When we speak of millions of men we are apt to picture to ourselves an almost boundless mass of humanity; yet a million men standing close together, each not occupying more than 4 square feet, could be placed on a patch but little more than a third of a mile square. A square mile will accommodate 7,965,000. At that rate the whole population of the United Kingdom would hardly cover nine miles square.

A substance which will resemble marble or alabaster may be made by mixing fresh plaster of Paris with a strong solution of alum and water into a smooth paste, and baking in an oven till hard: when cold, grind to fine powder and mix with water. At this stage any dry colour may be mixed with the plaster in such a way that it will run in streaks, but not get thoroughly incorporated with the mixture. Now run into a mould, and when set again bake, and when hard and cool dip in skimmed milk, and dry and polish with soft cloth and French chalk.

A Philadelphia shoe merchant says that two years ago a man came into his office in the last stages of alcoholic decline apparently, and exhibited an invention which would revolutionise men's shoe fastenings and make a fortune for some one. It was some sort of an arrangement which closed all the buttons at once by the turn of an invisible lever, and was as much of an improvement on the old method as the lever skate is upon the old-fashioned kind. That was the first and the last the merchant ever saw of man or model, and he is wondering now if the inventor's secret went to the grave. He cannot in the least recall the manner of working the fastening.

WHENCE THE WORLD'S WARMTH?

A novel theory to account for the warmth enjoyed by the world is advanced by an American scientist. Heat is a result, not a cause primarily. It is caused by impact, by attrition, by pressure, and by chemical action brought to bear upon caloric, which latter word is used in the sense of heat in a latent or inactive condition, such, for instance, as is found in a block of ice. Caloric may be some invisible thing comparable to attraction, existing in a quiescent condition, and pervading and filling the interstices of all matter, or it may be in the nature of atoms, so minute as to constitute the *ultima thule* of divisible matter. Whatever its nature, when aroused to action, it results in the degrees of warmth, heat or fire. This much is indisputable, and commonly known.

There would be no warmth, even in all the universe, if there were nothing to excite caloric to action. It is the impact of the sun's magnetic rays (so called) upon the surface of the earth that makes it warm as a whole, and wherever those rays strike their blows the most direct, there is the greatest force and consequent amount of warmth, because there the earth's caloric is caused the greatest amount of agitation. At the north and south poles, the surface of the globe is so curved away from the sun's direction that the caloric of those localities is not reached or touched at all at a certain time of the year, by the impact of the sun's rays. Consequently it remains undisturbed and inactive, therefore intense cold prevails. At the equator, the reverse of all this is true, and opposite conditions consequently are the result. The rays which reach the earth from the astral bodies outside this solar system are so retarded by counter attractions of the bodies of space, that they are detained in their course, and consequently ultimately reach the earth in a weakened and comparatively powerless condition; consequently the earth's caloric is but very slightly agitated by rays coming from astral directions, as scientific measurements prove to be the fact. All of the foregoing facts are indisputable, our authority claims, and in accordance with what is well known by men of learning.

Now the condition of the sun is, to-day, just what would be that of the earth if cut off, by distance or otherwise, from the approximate—near-by—rays, or influence, of the sun, with their powerful impact, *a frozen mass eternal*, as a whole. The granulations, resembling rice grains, or willow leaves, observed by astronomers, are, he continues, the surfaces presented of vast fields, and the limb protuberances immense mountains of ice and snow, which cover the sun's surface. The intensest cold of the whole solar system must prevail there. The planets of the system united could not send or return rays with force enough to the sun to warm one square mile of its surface; and the detained rays of the astral bodies arrive at the sun in too weakened a condition to exert a force worth the mentioning. There being, therefore, no power from a foreign source brought to bear to excite the sun's caloric to action, as a whole, a cold must prevail there which is many hundreds of degrees below zero—in fact, too intense for human conception. That the sun's rays, even which reach the earth are intrinsically cold, is proved by the fact that a burning lens constructed of ice will as readily set fire to any proper material as though made of glass.

But while it is true that the intensest cold known to man prevails in the sun, it is equally a fact, as revealed by the spectroscope, that the intensest of heat also prevails there; time, however, will show that while the former is general, the latter is local in character. For all physical phenomena there must exist an adequate natural cause, and this is eminently true of the phenomena of the sun. Extremes meet there which round up and emphasise the old adage.

And now the earth must be reverted to, in order to explain the extremes which exist at the sun, and hereby hangs the tale of a discovery, to which claim is made by the American astronomer referred to, and one fraught, if it be correct, with more importance to the human family than all others combined. In the frigid regions of Alaska, according to the reports of Professor Muir, of Muir glacier fame, there are to be found the remains of tens of thousands of dead elephants, mastodons, and other tropical animals. Also, upon the northern coast of Siberia, hundreds of these animals are washed ashore yearly, and every summer their ivory is gathered by the inhabitants of that country and made an article of commerce. Other explorers have found, in the coal measures of Melville Island, in the midst of the frozen arctic circle, the remains of a gigantic ultra-tropical vegetation for thousands of miles, radiating to every point of the compass, from Quito, Ecuador, South America. Years ago, traces were found of glacical action existing under what are now the vertical rays of a tropical sun on the equator itself. Vast masses of ice once existed in that region. The equatorial measurement of the earth from that point through to the opposite side lacks, in round numbers, two miles of its proper measurement to correspond with the rest of the equator. East and west from the above point, at 90 deg. distance each way, there may be traced a line encircling the globe, and bisecting both of its poles, along which the entire distance may to-day be found the remains of the flora and fauna of an ultra-tropical production, wherever there is land, regardless of present climatic conditions. All over the eastern and western hemispheres are the unmistakable evidences of the world having been flooded with oceans of waters, at a comparatively recent date, and in both are also found deposits and terminal moraines, (accumulations of earth and stones deposited by a glacier,) extending from the arctic circle down to about the fortieth parallel of latitude, which prove, positively, that the earth has gone through a glacial epoch which covered 100 deg. of its surface with fields and mountains of ice, thousands of feet in height and depth. Very much more of the earth's physical phenomena, of as amazing a character, might be cited, did the limits of this article permit, but enough is given for the purpose required. Many have been the speculative theories advanced by the scientific world, to account for the existence of the above mentioned phenomena, and to assign a natural, adequate cause therefor. But all the theories have thus far failed, each successive one having demolished its predecessor, until at last the universal sentiment prevailing is that as yet we do not know what was the ultimate cause of the glacial period.

Climatic conditions on the earth are almost wholly governed by the position it occupies to the sun, and to change climatic conditions one of two things must first take place, viz.. either the sun must sweep off in a direction lateral to the earth's orbit or the earth must turn over in a direction at right angles with the plane of its diurnal motion, a distance of 90 deg. in either case, to make the most radical change. That the former action cannot take place is evident from the fact that the sun's attractive power would carry the whole planetary system with it, and there would practically be no change of relative position, for there is no known foreign power sufficiently great to hold the earth fast and unchangeable under such circumstances. That the latter of the two things has taken place is unquestionable, for facts prove it. In no other way could the flora and fauna of an originally ultra-tropical region be thrown to the frigid zone, to perish under the changed climatical conditions which would be a natural consequence; in no other way could a reasonable account be given for the aforetime presence, in what is now an ultra-tropical region, situated right under the vertical rays of an

equatorial sun, of thousands of miles of ice ; in no other way can the earth's present flattened equator be accounted for, showing that it was once subject to centripetal force ; for no other known power could have produced such a result ; in no other way can a natural, adequate cause be given for the great cataclysms which have flooded the earth, in ages past, and left their unmistakable traces upon its surface to tell the tale to-day : in no other way can a satisfactory reason be given for the fossilised existence entirely around the land portion of the globe, independent of present climatic conditions, of the flora and fauna of an ultra-tropical region, and in no other way can the glacial epoch be accounted for only under the swaying action of the earth, as it has rocked temporarily back and forth, under the influence of the law of momentum, and that other influence which will be mentioned hereinafter.

Of course, when the earth, turning laterally upon its centre, reverses the position of its poles, and its equator, to a position 90 deg. distant from its original, there is a consequent and accompanying change of form to the amount of 26½ miles, reproducing the form of an oblate spheroid to that extent at right angles with its former position, and this is caused by the united action of centripetal and centrifugal laws. As a consequence of these laws, acting within and upon the earth, vast mountain chains will be wrinkled up in certain directions and sunk in others, and as a consequence of the awful and inconceivable pressure and attrition brought to bear, volcanoes will be brought into existence, some of them of tremendous size and of great extent, which will burn for a time, and then become extinct, in consequence of their heat returning to its original latent condition—of caloric—in the absence of further exciting cause.

If it were asserted that this third (principal) motion was peculiar to the earth alone, there would be a basis for a well founded suspicion as to the correctness of the assertion made because the principle is well established that the laws of nature are general in their application, action, and character, particularly those relating to the movements of the worlds of space. But no such assertion is made ; on the contrary, it is asserted that all worlds—be they suns, planets, or satellites—are governed and controlled by the same law, and subject to the same periodic motion, though occurring in different cycles of time.

Enough proof exists for the assertion, so far as Saturn is concerned. Like proofs exist so far as Jupiter is concerned, and Uranus does not fall short in other respects, though so far away. The very fact of a planet's existence with flattened equator proves incontestably that it has been placed under the power of centripetal force by having stood in the position of north and south—a direction at right angles with its present, for no other known power could have produced such a result. Upon the central turning of a planet it is placed in a position at right angles with that which it occupied before turning ; consequently the magnetic rays or currents of the sun are surrounding the planet in a direction at right angles with their former. As a natural consequence of this change of direction in the sun's magnetic rays, the planet becomes demagnetised to a limited extent. Centrifugal force remaining the same as before, owing to maintained diurnal motion, particles great and small are thrown off, and form rings around the planet to the extent of the weakness of its attractive power, while the balance goes into the solar system to be gathered up in after ages, as the given planet becomes recharged, and thus meteors and aerolites are gathered up, and the rings of planets disappear.

This subject has been continued farther than was necessary to simply account for the actual local heat of the sun, and which heat, with all its intensity to propel it, it is claimed, has never yet reached the earth, nor any other planet, or body of the solar system, the spectroscope, apparently to the contrary, notwithstanding. The local heat of the sun is mainly situated in the neighbourhood of both sides of its equator, and is caused wholly by volcanic action, which, in turn, was naturally caused by the awful pressure and attrition which was a necessary and inevitable consequence of its central turning and consequent change of form ages ago. The spots upon the disc of the sun, seen by astronomers, are but the mouths of tremendous volcanoes, our American astronomer tell us, and the smoke issuing therefrom. No heat, comes to the earth from them, he says, and that which is recognised as heat, here coming from the sun, is but a result of the impact of its magnetic rays, (for want of a true name) upon the caloric of all earthly matter, or things material. There is absolutely no heat, he furthermore asserts, radiated from the sun in any direction, and its magnetic rays are only reciprocal—alternate—between existing material bodies, such as the planets—their satellites, asteroids, the detritus, and debris of the solar system, comets, with, perhaps, a shadowy influence to and from the astral existences. The sun's corona, as seen during eclipse, is of the same nature and character as that of the blazing star in the distant heavens, which suddenly springs into existence, upon its central turning, and gradually dies away. Every star of the universes of space has been going through that ordeal, periodically, to all eternity. The volcanic heat of the sun disturbs and to a certain extent destroys the magnetic rays of those localities, and there result magnetic storms upon the earth.

The cause of the central, lateral, motion of the worlds of space, periodically, is primarily the cyclic revolution of their line of apsides. In the case of the earth, it takes about 20,900 tropical years for this line to complete one entire revolution. Its zero point is located in that part of its orbit where the earth is brought into perihelion at the time of the autumnal equinox. The earth then stands flatwise to the sun, charged with a magnetic force derived from more than seven million, six hundred thousand diurnal revolutions, with one pole rendered positive and the other negative to the sun's influence. The result is that one pole is attracted while the other is repelled, and the earth is turned over. The earth's last catastrophe occurred at a time at which certain chronologists have dated the creation of the world, the zero point of the astronomer's great year, and its recurrence will be about 15,000 years hence. And this is what has limited, and will always limit the earth's population throughout the eternal ages of its existence.

COMPOSITION OF THE EARTH.

Mr. F. W. Clarke, of the Philosophical Society of Washington, has made the following estimate of the relative quantity of the chief elements in the composition of the earth. He assumes for the earth's known crust a thickness of ten miles below sea level and includes the ocean and the air in his calculation. Oxygen, at 49·98 per cent. ; silicon, 25·30 ; aluminium, 7·26 ; iron, 5·08 ; calcium, 3·51 ; magnesium, 7·50 ; sodium, 2·28 ; potassium, 2·23 ; hydrogen, 0·94 ; citanium, 0·30 ; carbon, 0·21 ; chlorine and bromine, 0·15 ; phosphorus, 0·06 ; manganese, 0·07 ; sulphur, 0·04 ; barium, 0·03 ; nitrogen, 0·02 ; chromium, 0·01 ; total, 100·00. It is calculated that these nine elements form 98 per cent. of of the mass of the earth. Titanium, which is popularly supposed to be very rare, is seldom absent from the older rocks, Mr. Clarke says ; but having no striking characteristics and but little commercial importance, it is easily overlooked.

HOW TO RESIST COLD.

In our last issue we dealt with the influence of temperature on the value of life. Dr. W. B. Richardson further amplifies these views in the *Asclepiad*. He tells us that the fall of temperature produces a specified series of results, by reducing the force of the living organism, and disposing it to die. We may from this point investigate, from a physiological point of view, the mode by which the effect is produced in the economy. How does the decline of temperature act? Is the process simple or compound?

The process is compound, and into it there enter three elements. In the first place, the body is robbed rapidly of its waste force, and the reserve and active elements of force are, consequently, called upon to the depression of the organism altogether. This obtains because the medium surrounding the body, the air unless it be artificially heated, removes from its contact with the body a larger proportion of heat than can be spared; and it might be possible to produce such an influence on the body by sudden extraction of its heat as to destroy it at once by the mere act. If a man could be surrounded with frozen mercury he would die instantaneously, as from shock, by the immediate extraction of his heat. But in ordinary cases, and under ordinary circumstances, the mere rapid extraction of waste heat is not sufficient to account for all the mischief produced by a low temperature; for by artificial warmth and non-conducting garments, we counteract the influence, and that, too, in a manner which proves pretty successful. We may, therefore, leave this element of extraction of heat as a most important, but not as the sole, agent of evil.

The second element is the effect on the process of oxidation of blood under the influence of cold. We all are aware that if a portion of dead animal or vegetable matter be placed at a low temperature, it keeps for a considerable time; and we have evidence of dead animals which, clothed in thick ribbed ice, have been retained from putrefaction for centuries. Hence we say that cold is an antiseptic as alcohol is, and chloroform, and ammonia, and other similar bodies. Cold is an antiseptic then, but why? Because it prevents, even in the presence of a ferment, the union of oxygen gas with combustible matter. The molecules of oxygen, in order that they shall combine, and in their combination evolve heat, require to be distributed, and to be distributed by the form of motion known as heat; deprive them of this activity, and they come into communion with themselves, are attracted to each other, and lose to the extent of this attraction their power of combining with the molecules of other bodies for which they have an affinity. But perfect combination of oxygen and carbon in the blood is essential to every act of life. In the constant clash of molecule of oxygen with molecule of carbon in the blood lies the mainspring of all animal motion; the motion of the heart itself is secondary to that. Destroy that union, however slightly, and the balance is lost, and the animal body is, in a plain word, *ill*. It is the easiest of the demonstrative facts of physiological science that reduction of temperature lessens the combining power of oxygen for blood, and therewith causes a reduction of animal force, and a tendency to arrest of that force, which, in the end, means *death*.

The third element in the action of cold is more purely mechanical, and this, though in a sense secondary, is of immense import. When any body, capable of expansion by heat, that is to say, by radiant motion of its own particles, is reduced in temperature, it loses volume, contracts or shrinks. The animal body is no exception to this rule; a ring that will fit tightly to the warm finger will fall off the same finger after exposure to cold. The whole of the soft parts shrink, and the vessels contract and empty themselves of their blood. Cold applied to the skin in an extreme degree blanches the skin, and renders it insensible and bloodless, so that if you prick it, it does not bleed, neither does it feel. In cases where the body altogether is exposed to extreme cold this shrinking of the external parts is universal; the whole surface becomes pale and insensible; the blood in the small vessels superficially placed is forced inward upon the heart and vessels of the interior organs; the brain is oppressed with blood; sleep or coma, as it is technically called, follows, and at last life is suspended.

In exposure to the lowest wave of temperature in this country these extreme effects are not commonly developed; but minor effects are brought out which are most significant. In particular, the effect on the lungs is strongly marked. The capillary vessels of the lungs, making up that fine network which plays over the computed six hundred millions of air vesicles, undergo paralysis when the cold air enters, and in proportion as such obstruction from this cause is decisive, the blood that should be brought to the air vesicles is impeded and the process of oxidation is mechanically as well as chemically suppressed. The same contraction is also exerted on the vessels of the skin, driving the blood into the interior and better protected organs. Hence the reason why on leaving a warm room to enter a cold frosty air there is an immediate action of the visceral organs from pressure of blood on them, and not unfrequently a tendency to diarrhœa from temporary congestion of the digestive tract. Three factors are at work, in fact, whenever the low wave of temperature affects the animal body; abstraction of heat from the body, beyond what is natural; arrest of chemical action and of combustion; paralysis of the minute vessels exposed to the cold.

We cannot view the extent of change in the organic life induced by the low wave of heat without seeing at once the sweep of mischief which exposure to the wave may effect. It exerts an influence on healthy life in the middle-aged man, and we know of no disease which it does not influence disastrously. Is the healthy man exhausted, it favours internal congestion; has he a weak point in the vascular system of his brain, it renders that point liable to pressure and rupture, with apoplexy as the sequence; is he suffering from bronchial disease, and obstruction, already, in his air passages, here is a means by which the evils are doubled; has he a a feeble, worn-out heart, it is unable to bear the pressure that is put upon it; has he partial obstruction of the kidney circulation, he is threatened with complete obstruction; is he indifferently fed, he is weakened generally. It is from this extent of action that the mortality of all diseases runs up so fast when the low wave of heat rolls over the population, affecting, as we have seen, the feeblest first.

Another danger sometimes follows which is remote, but may be fatal, even to persons who are in health. It is one of the best known facts in science that when a part of the surface of the body has been exposed long to cold, the greatest risk is run in trying suddenly to warm it. The vessels become rapidly dilated, their coats relax, and extreme congestion follows. But what is true of the skin is true equally, and with more practical force, of the lungs. A man, a little below par, goes out when the wave of temperature is low, and feels oppressed, cold, weak, and miserable; the circulation through his lungs has been suppressed, and he is not duly oxidising; he returns to a warm place, he rushes to the fire, breathes eagerly and long the heated air, and adds to the warmth by taking perchance a cup of stimulant; then he goes to bed

and wakes in a few hours with what is called pneumonia, or with bronchitis, or with both diseases. What has happened? The simple physical fact of reaction under too sudden an exposure to heat after exposure to cold. The capillaries of the lungs have become engorged, and the circulation static, so that there must be reaction of heat, inflammation, before recovery can occur. Nearly all bronchial affections are induced in this manner, not always nor necessarily in the acute form, but more frequently by slow degrees, by repetition and repetition of the evil. Colds are often taken in this same way, from the exposed mucous surfaces of the nose and throat being subjected first to a chill, then to heat.

The wave of low temperature affecting a mixed population finds inevitably a certain number of persons of all ages and conditions on whom to exert its power. It catches them too often when they least expect it. An aged man, with sluggish heart, goes to bed and reclines to sleep in a temperature, say, of 50° or 55°. In his sleep, were it quite uninfluenced from without, his heart and his breathing would naturally decline. Gradually, as the night advances, the low wave of heat steals over the sleeper, and the air he was breathing at 55° falls and falls to 40°, or it may be to 35° or 30°. What may naturally follow less than a deeper sleep? Is it not natural that the sleep so profound shall stop the labouring heart? Certainly. The great narcotic never travels without fastening on some victims in this wise, removing them, imperceptibly to themselves, into sleep ending in absolute death.

The study of the physiological influence of the wave of low temperature, and of its relation to the wave of mortality, suggests a few rules, simple, and easily remembered. 1. Clothing is the first thing to attend to. To have the body, during variable weather, such as now obtains, well enveloped from head to foot in non-conducting substance is essential. Who neglects this precaution is guilty of a grevious error, and who helps the poor to clothe effectively does more for them than can readily be conceived without careful attention to the subject we have discussed. 2. In sitting-rooms and in bedrooms it is equally essential to maintain an equable temperature; a fire in a bedroom is of first value at this season. The fire sustains the external warmth, encourages ventilation, and gives health not less than comfort. 3. In going from a warm into a cold atmosphere, in breasting the wave of low temperature, no one can harm by starting forth thoroughly warm. But in returning from the cold into the warm, the act should always be accomplished gradually. This important rule may readily be carried in mind by connecting it with the fact that the only safe mode of curing a frozen part is to rub it with ice, so as to restore the temperature slowly. 4. The wave of low temperature requires to be met by good, nutritious, warm food. Heat-forming foods, such as bread, sugar, butter, oatmeal porridge, and potatoes, are of special use now. It would be against science and instinct alike to omit such foods when the body requires heat. 5. It is an entire mistake to suppose that the wave of cold is neutralised in any sense by the use of alcoholics. When a glass of hot brandy and water warms the cold man, the credit belongs to the hot water, and any discredit that may follow to the brandy. So far from alcohol checking the cold in action, it goes with it, and therewith aids in arresting the motion of the heart in the living animal, because it reduces oxidation. 6 Excessive exercise of the body, and overwork either of body or of mind, should be avoided, especially during those seasons when a sudden fall of temperature is of frequent occurrence. For exhaustion, whether physical or mental, means loss of motion in the organism; and loss of motion is the same as loss of heat.

One further consideration, suggested by the subject of this paper, has reference to the bearing of the public toward the labours of the medical man in meeting the effects of the low wave of heat. The public, looking on the doctor as a sort of mystical high priest who ought to save, may often be dissatisfied with his work. Let the dissatisfied think of what is meant by saving when there is a sudden fall in the thermometer. Let them recall that it is not bronchitis as a cause of death, nor apoplexy, nor heart disease, as such, that the doctor is called on to meet; but an all-pervading influence which overwhelms like the sea, and against which, in the mass, individual effort stands paralysed and helpless. When the doctor is summoned the mischief has at least commenced, and, it may be, is so far over that treatment by mere medicines sinks into secondary significance. Then he, true minister of health, candid enough to bow humbly before the great and inevitable truth, and professing no specific cure by nostrum or symbol, can only try to avert further danger by teaching elementary principles, and by making the unlearned the participators of his own learning

SOMETHING WE ARE FEELING FOR.

Mr. Flinders Petrie recently delivered at the Owens College, Manchester, a most interesting address on exploration in Egypt. It had been thought, he said, that the immense mounds of rubbish indicating the sites of towns had been made on purpose, but they resulted from the natural decay of the mud brick buildings. These heaps of ruined walls and earth and potsherds rose even to eighty feet high in some places; but other ancient sites were much less imposing and might even not attract notice on the open desert. The higher the mound the longer the place had been inhabited: and if the surface was of a late period, the earlier parts, which were most needed, were under such a depth of rubbish as to be practically inaccessible. Much could be known at first sight; and prospecting had now become as scientific a matter in antiquities as in geology. Knowing, by a glance at the sherds on the top, what was the latest period of occupation of the site, and knowing the usual rate of accumulation of a mud brick town—about five feet in a century—we could guess how far back the bottom of the mound must be dated. Other remains had different indications. If in the midst of a great mound there was a wide flat crater, that was probably the temple site, surrounded by houses which had accumulated high on all sides of it. Speaking of the results of exploration, Mr. Petrie said that we now realised what the course of the arts had been in Egypt. In the earliest days yet known to us—about 4000 B.C.—we found great skill in executing accurate and massive stone work, such skill as had hardly ever been exceeded. We found elaborate tools used, jeweled saws and tubular drills. We saw the pictorial arts as fully developed as they were for thousands of years later. But what led up to this we were still feeling for.

As many as 3,528 pores have been counted on 1 square inch of the palm of the hand. There are about 7,000,000 pores in an ordinary sized man, or 1,750,000 inches of pores, that is 145,833 feet, or 48,600 yards; nearly 28 miles of this drainage in the human body.

TO INVENTORS. Anyone having a good Invention can, on applying to the Editor, "Science Siftings," obtain the advice and assistance of a well-known Patent Expert, free of charge.

REVELATIONS OF THE MICROSCOPE.

If you will take a drop of water from any stagnant pool and examine it under a microscope, you will find it filled with minute forms of life called infusoria and diatoms—the former sometimes having shells of varied and curious shapes, while the limy cases in which the latter are inclosed exhibit an infinite variety of most exquisite patterns. When these creatures die their soft parts quickly decompose, but the little dwellings they have occupied remain imperishable. In such countless myriads do small beings of this sort throng the oceans and even the earth itself wherever it is moist, and so rapidly do their myriad generations succeed one another, that shells of their ancestors which perished ages ago are now found in a fossil state, composing entire ranges of mountains and covering the land in many parts with a layer several feet in thickness. So full is the crust of this planet of such remains, that when a particle of earth has been mixed with a drop of water and the liquid has been permitted to evaporate from a glass slide, the smallest stain left upon the surface abounds with curious structures, whose living types inhabit the waters of to-day. It is believed that the atmosphere abounds with their eggs, which, being inconceivably light, are carried about by the winds in unseen clouds.

Near Bilin, in Bohemia, a stratum of slate has been discovered 14 feet thick, entirely composed of the shells of diatoms. It is used when ground as a polishing powder, under the name of "tripoli," and a single apothecary in Berlin sells more than 2000 pounds of it yearly for this purpose. A single cubic inch of this material contains no less than 40,000,000,000 distinct organic forms. In Sweden and Lapland a white, mealy earth exists, distributed in layers and sometimes 30 feet in thickness. It is wholly composed of the shells of diatoms and when mixed with the pulverised bark of trees is used by the inhabitants as an article of food in times of scarcity.

Chalk consists in great measure of such fossil structures, together with the shells of almost microscopic animals called "foraminifera," which largely compose the beds of all the seas. Flint—that substance typical of enduring—has been proved to be of like origin, being composed chiefly of the shells of minute creatures, mingled with the scales of fishes etc. Some of the foraminifera, however, are of comparatively large size— notably a sort about the shape and size of a four-shilling piece, which from their resemblance to coins have received the name of "nummulites," or fossil money. It has been said that their remains "have added more to the mass of materials composing the crust of the globe then the bones of all the elephants, whales, hippopotami and other monsters that ever lived." This, however, is stating the case very feebly. Whole mountains are made of them. The vast limestone range at the head of the Adriatic gulf is composed almost entirely of nummulites, and at Suggsville, in the United States, is a chain of hills 300 feet high, literally made up of a single species of this fossil. The city of Paris is built of them and the great pyramid of Egypt is similarly constituted. It is thought that the same is true of the stupendous Andes, which are conjectured to have been originally formed of minute organised remains. Much of the sand of the Desert of Sahara consists of the fossil shells of small animals.

The diatoms which crowd the seas are devoured in multitudes by escallops and other molluscs. When the stomachs of such animals are examined they are found to contain myriads of microscopic shells, the soft parts having been digested. These limy and flinty cases afford a most interesting and delightful study to the student of microscopy, under whose instruments are revealed an astonishing variety of elaborate and exquisite patterns. Guano has been found to contain many beautiful forms of diatoms, which have lost none of their perfection of structure, although they must have gone through the process of digestion twice and have been subjected to the action of the elements of centuries. Necessarily, they were first swallowed by fishes, which subsequently became the prey of the voracious sea birds that produced the guano.

Of the purpose which such minute organisms as those described serve in the economy of nature, nothing certainly is known, although some light is thrown upon the question by Prof. Owen, who says: "Consider their incredible numbers, their universal distribution, their insatiable voracity, and that it is the particles of decaying vegetable and animal bodies which they are appointed to devour and assimilate. Surely we must, in some degree, be indebted to these ever active, invisible scavengers for the salubrity of the atmosphere and the purity of the water. Nor is this all; they perform a still more important office in preventing the gradual diminution of the present amount of organised matter upon the earth. For when this matter is dissolved or suspended in water, in that state of comminution and decay which immediately precedes its final decompostion into the elementary gases, and its consequent return from the organic to the inorganic world, these wakeful members of nature's invisible police are everywhere ready to arrest the fugitive organised particles and turn them back into the ascending stream of animal life. Having converted the dead and decomposing particles into their own living tissues, they themselves become the food of larger infusoria and the numerous other small animals, which in their turn are devoured by larger animals. And thus a food fit for the nourishment of the highest organised beings is brought back by a short route from the extremity of the realms of organised matter."

THE ANXIOUS CAMEL.

The ordinary load for a camel is about 600 pounds for long journeys, although if the journey is to last only a week or ten days 1000 pounds weight is frequently placed on the back of an average animal, but not without strenuous objection on the part of the beast, who watches the process of loading with great anxiety, and frequently interrupts it by rising and refusing to kneel to receive more. The speed of the camel when on a journey of considerable length rarely exceeds three miles an hour, and the swiftest dromedaries are rarely known to go faster than a ten-mile gait, but this can be kept up for twenty hours in the day and for six or seven days at a time. It has been said that a lightly laden camel will take with the same foot thirty-eight strides a minute, each being about 7 feet. The foot of the animal is large, soft and spongy, thus enabling it without difficulty to traverse the yielding sands. The first stomach of a camel has a division which can be closed at the pleasure of the animal, and in the walls of this stomach are many large cells, capable of great extension. When the animal drinks, the water is passed into these reserve cells and thence given forth as necessity requires. A camel of the largest size has been known to drink from thirty to fifty gallons and then travel without water for twenty days. The water remains pure, and numerous instances are on record in which human life has been saved in the desert by killing a camel and using the water from its stomach.

WHAT ELECTRICITY IS DOING.

Electricity is working revolutions in almost every department of science, industry and commerce, and marvellous transformations are being wrought throughout the civilised world by this new and wonderful agent the marvel of the age. Nothing like it has ever before been seen. The introduction and history of steam is tame when compared with it.

Electricity touches life and industry at every possible point, modifying, transforming and extending all previous methods and practice. It has already annihilated time and space. It will put a girdle around the earth in the smallest fraction of a minute. It connects the earth with the sun in an almost measureless minimum of time. With all its wonderful and almost irresistible power, it is quite as ethereal as light itself, and we are fast finding out that it can be mastered, controlled and rendered as harmless as the most innocent thing in nature. Regarding it in all its known conditions in relation to time, space and force, may we not regard it as the means of differentiating as the connecting link indeed between the material and the immaterial world? All of this and more, especially when we consider that we have the fullest reason to believe that the immediate future bids fair to transcend all the realisation of the past. From a mere toy, electricity has, within half a lifetime, made all of this advance. In regard to the future, it is quite as rash to say "We shall not," as to say "We shall."

Nothing, perhaps, in electrical progress, exceeds the history of the telephone. Its introduction marks an epoch. At first we knew it as a means of speaking only from room to room. It next passed out into the street, then along the suburban wayside to an adjoining town. Then it halted for a time. Gradually, long-distance telephoning became the dream of the scientist and inventor. At first its voice was weak and almost inarticulate, even when the distance was recorded in rods. The scientist and the inventor kept steadily at work until we got the microphone transmitter, which was soon followed by the induction coil and other important accessories and assimilating elements, until we now have the long-distance telephone very nearly or quite fully developed. Continents may now be traversed with, perhaps, relays at long distances, and there is good reason to believe that they might even now be fully traversed by more expensive appliances than economy would, just at this time, warrant. In fact, arrangements are even now being made to telephone across the Atlantic. That the experiment will be successful, who that knows, can doubt? The tick of a watch can now be heard by the submerged wire between Dover and Calais, and the telephone between London and Paris is proving a big success, scientifically, commercially and financially. Electricians say there is no telephone circuit in London, or in England that works so clearly and perfectly.

The telephone will soon become as important to international commerce as it now is to that between town and town, although we have as yet reached only the mere fringe of telephony, as will be fully seen when ultimate development has been reached.

THE NEWLY BORN LAKE.

The phenomenon of a new lake in the Colorado desert that so puzzled and astonished geologists a few months back, has now been investigated and reported on by Mr. J, J. Mc Gillivray, of the United States Mineral Survey Service.

"None of the papers, so far as I know," says Mr. McGillivray, "have described with much accuracy or detail the interesting thing which has happened in the Colorado desert or have stated how it happened. The Colorado desert lies a short distance north-west of the upper end of the Gulf of California, and contains not far from 2,500 square miles. The Colorado River, which has now flooded it, has been flowing along to the east of it, emptying into the Gulf of California. The surface of the desert is almost all level and low, some of it below the sea level. Some few hundreds of years ago it was a bay making in from the Gulf of California, and then served as the outlet of the Colorado River. But the river carried a good deal of sediment, and in time made a bar, which slowly and surely shut off the sea on the south, leaving only a narrow channel for the escape of the river, which cut its way out, probably at some time when it was not carrying much sediment. Then the current became more rapid and cut its way back into the land, and, in doing this, did not necessarily choose the lowest place, but rather the place where the formation of the land was soft and easily cut away by the action of the water.

"While the river was cutting its way back it was, of course, carrying more or less sediment, and this was left along the banks, building them all the time higher, and confining the river more securely in its bounds. That is the Colorado River as we have known it ever since its discovery. Meantime, the water left in the shallow lake, cut off from the flow of the river, gradually evaporated—a thing that would take but a few years in that country, where the heat is intense and the humidity very low. That left somewhere about 2,000 miles of desert land, covered with a deposit of salt from the sea water which had evaporated, and most of it below the level of the sea. That is the Colorado desert as it has been known since its discovery.

"Then, last spring, came the overflow which has brought about the present state of affairs. The river was high and carrying an enormous amount of sediment in proportion to the quantity of water. This gradually filled up the bed of the stream and caused it to overflow its banks, breaking through into the dry lake where it had formerly flowed. The fact that the water is salt, which excited much comment at the time the overflow was first discovered, is, of course, due to the fact that the salt in the sea water which evaporated hundreds of years ago has remained there all the time, and is now once more in solution.

"The desert will, no doubt, continue to be a lake and the outlet of the river unless the breaks in the banks of the river are dammed by artificial means, which seems hardly possible, as the river has been flowing through the stream 200 feet wide, four feet deep, and flowing at a velocity of five feet a second.

"It is an interesting fact to note that the military survey made in 1853 went over this ground and predicted the very thing which has now happened. The flooding of the desert will be a good thing for the surrounding country, for it does away with a large tract of absolutely useless land, so barren that it is impossible to raise there what the man in Texas said they mostly raised in his town, and it will increase the humidity of the surrounding territory. Nature has done with this piece of waste land what it has often been proposed to do by private enterprise or by public appropriation. Congress has often been asked to make an appropriation for that purpose."

Mr. McGillivray had also some interesting things to say about Death Valley, which he surveyed.

"It has been called a *terra incognita* and a place where no human being could live. Well it is bad enough, but

perhaps not quite so bad as that. The great trouble is the scarcity of water and the intense heat. But many prospecting parties go there looking for veins of ore and to take out borax. The richest borax mines in the world are found there. The valley is about 75 miles long by 10 miles wide. The lowest point is near the centre, where it is about 150 feet below the level of the sea. Just 15 miles west of this central point is Telescope peak, 11,000 feet above the sea, and 15 miles east is Mt. Le Count, in the Funeral mountains, 8,000 ft high. The valley runs almost due north and south, which is one reason for the extreme heat. The only stream of water in or near the valley flows into its upper end and forms a marsh in the bed of the valley. This marsh gives out a horrible odour of sulphureted hydrogen, the gas which makes a rotten egg so offensive. Where the water of this stream comes from is not very definitely known, but in my opinion it comes from Owen's lake, beyond the Telescope mountains to the west, flowing down into the valley by some subterranean passage. The same impurities found in the stream are also found in the lake, where the water is so saturated with salt, boracic acid, etc., that one can no more sink in it than in the water of the Great Salt Lake; and I found it so saturated that after swimming in it a little while the skin all over my body was gnawed and made very sore by the acids. Another reason why I think the water of the stream enters the valley by some fixed subterranean source is the fact that, no matter what the season, the flow from the springs that feed the marsh is always exactly the same.

"The heat there is intense. A man cannot go an hour without water without becoming insane. While we were surveying there, we had the same wooden cased thermometer that is used by the signal service. It was hung in the shade on the side of our shed, with the only stream in the country flowing directly under it, and it repeatedly registered 130°; and for 48 hours in 1883, when I was surveying there, the thermometer never once went below 104 degrees."

AN AMUSING AND INSTRUCTIVE TOY.

An interesting experiment to prove the difference between the action of hot and cold air may be effected with an ingenious toy, the patent of M. Munier, of 5, Rue Guilhem, Paris. A small and light rotary blower is provided with a multiplying wheel and crank handle. At the indraught of the blower a little spirit lamp is fixed, so that the air may be heated as it enters. The orifice of the blower is large, and by dipping this orifice into soap solution, and then turning the winch, it is easy to blow a bubble of hot air from 12 to 16 inches in diameter. These bubbles rise from 60 to 100 feet in the air, and can be applied to many pretty experiments. For instance, a piece of magnesium wire, fixed beneath a paper shield, can be attached by a thread to a thin caoutchine disc, and supported by the soap bubble. After igniting the magnesium we may release the bubble, which, being virtually a hot air balloon, will raise the pendant wire to a considerable height. Or the magnesium wire may be replaced by a sheet of flash paper, to which a strip of slow burning paper is attached. The instrument is sold at 8s. 6d.

Divers in the clear waters of the tropical seas find that fish of different colours, when frightened, do not all dart in the same direction, but that each different kind takes shelter in that portion of the submarine growth nearest in colour to that of the fish.

PHRENOLOGY EXPLAINED.

By Stackpool E. O'Dell,
Author of "Phrenology: its Truthfulness and Usefulness," "Old St. Margaret's," "Merciful or Merciless?" "Brompton Lectures," "Mental Troubles," etc.
[RIGHTS RESERVED.]

XI.

The organ of language is known by the eyes having the appearance of being pressed forward and downward according to its power. This is the first organ that Gall made observations upon. Those of the pupils in the school where he was educated who manifested ability in the remembering of words possessed this peculiarity we have mentioned in the appearance of the eyes. Language is understood by all in various degrees, according to wants, requirements, observations, and general culture. Now the understanding of language is one thing, while the reproducing of it is another, and it is the reproducing of language we would consider here; of course, we mean the language of words, either oral or written. This ability to reproduce language comes from a distinct organ, and is not altogether a matter of general mental culture; if it were so, we should expect every University man who has taken degrees or honours to manifest the power of speech, while those who are deficient in general mental culture would be minus this power. We know as a fact that this is not the case, for uneducated men and women may have great fluency of speech, while there are very many of the highly educated who cannot string together a few sentences in order to propose a vote of thanks, and they are likewise inferior conversationalists. Those who would wish to succeed in life in important occupations or professions are necessitated to have this organ fairly prominent. It is required in ordinary business pursuits as well as on the platform or in literature. This faculty tends very much to help us in gaining the respect and confidence of each other, notwithstanding that language is only spoken of as silver, while silence is compared to gold. If this proverb be applied generally, every thoughtful man will see that it is misleading. One does not go too far in saying that language is a great if not the greatest of all powers. Where would civilisation be were it not for it? In all departments of life—social, commercial, religious, or political—the battle is very much with the tongue, and the best talker will have the largest audience and greatest influence. We do not say that this should be, but that it is. In order to equip one for the battle of life, a special effort should be made to cultivate this faculty. We should learn not alone the meaning of words, but how to express them, both in private and public life. For this purpose, reading the best authors is good, and so is writing essays, that will express our ideas, but a man may read and write for ever so long without being a good speaker, if he does not make an effort to converse about and discuss those subjects that he has studied. The fact of it is that you can become a good talker if you practice talking. Speak! Speak upon every occasion you possibly can; seek occasions, and make them. Go to debating societies, discussion classes, public meetings that are open to questions, and ask questions. With training of this nature you will find this faculty developing with much rapidity. Although all who thus practice may not become orators, yet all will be improved in their conversational abilities. Fear that oftentimes comes through want of confidence is very aggressive to this faculty. A man wishes to speak either among his personal friends or in

public about some subject of more or less importance; he feels he has some good ideas and expresses them to himself with ability that he cannot help but recognise, but when he makes the effort to speak before others, want of confidence, fear of not being able to do so as well as he would wish, of not being able to continue or conclude the subject to his liking, has such an effect upon the nervous tissue of his brain, that his thoughts become confused and his memory fails him. This possibly results in a breakdown, more especially if speaking in public. This often disheartens and discourages. There were never so many opportunities of cultivating this faculty as at present. There were never so many inducements. All social, political, and religious subjects are discussed by the people, while public life is not confined to vestries; we have local boards and county councils; we may have parish councils and local parliaments, so we shall want more speakers.

THE HIGHEST LAKE.

The highest known lake on the face of the globe is Sir-i-Kol, in Turkestan, 15,630 feet above the sea. Many others, however, in various countries, are at a considerable elevation. The chain of great American lakes, the Great Bear Lake and Lake Athabasca and Winnipeg are from 200 to 600 feet above the sea, while there are many more than 1000. In the United States, Moosehead Lake, in Maine, is 1070; Salt Lake, 4200, and the Lake Tahoe, in California, 6500. In Europe, Lake Geneva is 1030; Lake Constance, 1263; in Africa, Lake Nyassa is 1300; Tanganyika, 2800; Bangweole, 4000; Victoria Nyanza, 3800, and Albert Nyanza, 2700. In Asia, besides Sir-i-Kol already mentioned, there is lake Baikai, in Siberia, 1420, and Van, in Armenia, 5467. Two lakes in South America have also a very great altitude. Lake Aullagus is 12,257 feet above the sea and Lake Titicaca 12,850. There also several lakes considerably below sea level, of which the most notable example is the so-called Dead Sea, in Palestine, 1312 feet below the level of the Mediterranean.

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SCIENCE NEWS AND NOTES.

"Every noble life leaves the fibre of it interwoven for ever in the work of the world."—*Ruskin.*

We have Awarded the Prize

for the best article on "The Condition of Man in 1991" to Mr. Alexander Jameson, Elswick Court, Northumberland-street, Newcastle-on-Tyne, to whom a cheque for five guineas has been forwarded. Mr. Jameson's contribution appears in another column, and we think that all who competed for this prize will agree that our award has not been misplaced. The subject has been treated as comprehensibly, we think, as the word-limit would permit, although Mr. Jameson, like every other competitor for the prize, has chosen rather to write of the conditions under which man will live in 1991, than to treat of the actual condition of man. As this error seems to have been universal amongst those who contested the prize, we have given it to the best all-round effort. After all, we cannot expect any great evolution in man in a paltry century, although the conditions under which he lives at present are far more radical than those at any other period.

We Wish our Readers

a very happy New Year, and, as they will notice, we inaugurate it with a change in the colour of our cover. This is only a change of coat, not a turning of it, and is due to the fact that many of our readers have been calling for something brighter about our exterior, we think all are satisfied with our interior. Our general programme will be the same as heretofore, and, as one of the items in that programme is to endeavour to please every individual reader, we trust our friends will let us know what their wishes are, and they may rest assured we shall make an early effort to gratify them.

One Change

that we have to announce is the cessation of the "Coupon" competitions. This is also in deference to the wishes of a great number of readers. We shall duly award the prize earned up to date, and substitute a series of literary and scientific competitions of a very varied nature, so that everybody may enter the lists and take away a prize.

Adulteration of Food

is not nearly as serious a question as formerly, because those manufacturers and vendors who had a tendency to be dishonest in this direction, are somewhat more wary than formerly, owing to the exemplary fines for second offences. The decision given a few days ago in the Woolwich Police Court, in the case of the Woolwich Board of Health *v.* Robert Purves, if it is good in law, will greatly affect all future magisterial rulings. The magistrate dismissed the summons because it appeared to be a trade custom to adulterate cocoa, and because the Act provides that "the offence shall not be deemed to be committed where any matter of ingredient not injurious to health has been added to the food because the same is required for the production or preparation thereof as an article of commerce, and not fradulently to increase the bulk of the food." This is all very well, but we imagine when people ask for cocoa, they believe they obtain cocoa, and not only 40 per cent. of cocoa, with 60 per cent. of foreign ingredients, as was the case here. Here we have the adulterating matter actually preponderating over the ingredient from which the article takes its name; and if 60 per cent. of adulteration is to be legalised, without a tradesman being compelled to make any admission to that effect, what is to prevent the introduction of 99 per cent. of alien stuff? Would it be justifiable to call a preparation cocoa, if it only contained 1 part of cocoa to 99 parts of starch and sugar? Trifling adulteration of coffee with chicory is illegal, unless it be declared on the package, although chicory may also be considered healthful and an improvement to some coffee. Why should one law apply to cocoa—the poor man's food—and another to the rich man's beverage—coffee?

Our Food Supply

is a topic that Dr. Andrew Wilson has found of such scientific interest that he has not hesitated to treat it diffusely. He considers the comparative limitation of our daily menu a topic upon which it is easy to descant at

considerable length. One hardly ever returns home from a Continental trip, for example (to say nothing of excursions to parts much farther off), without tacitly agreeing with the remark that foreigners exhibit a very much more extensive bill of fare than is the possession and glory of the British paterfamilias. This is entirely due to what the journalists call "insular prejudice." This last is a fine-sounding, comprehensive term, which, like the old lady's blessed "Mesopotamia," sounds well, and "means a lot," as the school-boy puts it. Truth to tell, however, it is undeniable that we Britishers are a very conservative nation in the matter of food. We may be as radical as we like in other matters, but we draw the line at our comestibles. A worthy lady made the remark to Dr. Wilson that, in the perplexity of attempts to vary her household bill of fare, she often devoutly wishes that Providence would "create some new animal to eat." Unfortunately, Providence will do nothing of the kind, especially as there are plenty of "animals to eat" already in existence. What the worthy woman should pray for is an enlightenment of our stolid understandings, that we may be led to see that there are many other animals good to eat besides oxen and their young, sheep, pigs, and barn-door fowls and their youthful progeny.

One Naturally Turns to the Sea

for enlightenment on this variation of the food-question. Inexhaustible in its food resources, one may well maintain that it is rather to Billingsgate than to Smithfield we may look for the extension of our diet-materials—leaving out of sight what is, of course, a notable point, that improved ideas of cookery will undoubtedly affect in a wholesome fashion the enlargement of the British bill of fare, which is an argument for the cultivation of culinary knowledge everywhere. The sea supplies us fairly well, as things are, with a varied assortment of foods, from periwinkles and mussels (the latter delightful as a source to boiled or fried fish) to the plebeian cod, the dainty herring, and the lordly salmon itself. Only, we have not reached the limits of the ocean's loving-kindness to us by any means, or by many hundreds of varieties of eatable things. Once upon a time, incited to the experiment by Mr. Gosse's writings, Dr. Wilson tried to cook a couple of big sea-anemones. The experiment was a dismal failure. The culinary authority flatly refused to have anything to do with "cooking jelly-fishes" (as she put it); and the worthy scientist's own knowledge of practical cookery being of limited character, what resulted was neither pleasant to the eye, tender to the teeth, nor digestible by one's internal mechanism. Still there is no reason why we should not eat anemones. One man once liked them immensely. They resembled cod, so he said; but he ate them properly cooked (stewed), and he enjoyed the tremendous advantage also of having them served up with an appropriate sauce.

From Anemones to Cuttle-fishes

is a wide step zoologically. From a culinary standpoint the two classes of animals are not very far apart. You might object to eat an anemone for many reasons, it is true; but there is no earthly reason why you should ever turn up your nose at a nice octopus or tender squid. Abroad, of course, cuttle-fishes are eaten regularly. They taste like tripe, which everybody admits is very readily digested; but prejudice, wretched prejudice, again comes to the front of things. A week or two ago, when Dr. Wilson was enjoying a lazy holiday, fishing in Largo Bay, a little octopus took the bait, and was duly drawn up by the line. When he was asked "what he was going to do with that thing," he replied that he intended to preserve it, or that he might eat it. His interlocutor held up his hands in sheer amazement at the statement. "Eat *that*!" ejaculated he, "Man, you would be poisoned!"—and yet people will tell us that the age of prejudice is over, and that everybody is free and enlightened!

The Crab and Lobster Tribes

come next—these are the crustaceans of zoology. The above-named, with the shrimps, prawns, spiny lobsters or sea cray-fish), the fresh-water cray-fish, and the deli-(ate Norway lobsters (or *Nephrops*) sum up our spoils from che shell-fish class; oysters and the molluscs—our octopus being but a kind of superior oyster when all is said and done—is left out of consideration here. Very recently Professor Herdman, of Liverpool, addressed a note to a contemporary, suggesting that within the limits of the lobster class we might obtain certain animals which should prove to be admirably adapted for food. He himself had tried certain of the crustaceans (related to the shrimps and prawns) which abound on the sea's surface, and which may be captured in thousands by aid of a tow-net. These animals, he asserts, were delicious eating, and as they are so nearly related to our prawns and others of that ilk, no rational being may refuse to join us in our new likings, by reason of any sentimental objections to trying a new and unwonted kind of diet. Another correspondent, writing of Professor Herdman's experiment, says he has long held that these surface-living crustaceans might be made to afford a very admirable diet The Greenland whale feeds upon them, drawing them by thousands into his mouth, where they are strained off from the water, and entangled in his whalebone plates.

The Food Supply of the Ocean

would appear, then, practically unlimited. True, crabs and lobsters are not generally regarded as very satisfying articles of diet; but the same objection applies to fish itself. There is not the staying power in fish that exists in beef; but then we all eat too much butcher meat (those of us at least who are well enough off to own a butcher's book), and even your working man thinks he is not fed at all unless he has a fair preponderance of steak or allied comestible included in his dietary as frequently as may be. One thing is certain, that, however we feed ourselves, a change of diet is not only wholesome, but necessary, and the practice of living twice a week or so upon fish, as a *pièce de resistance*, is to be recommended for hygienic reasons, apart from any religious motives which may incite to such a rule of diet. Dr. Andrew Wilson goes further than this, however, and avers that our food-habits all round demand reform, chiefly in the direction of greater simplicity of living, but not less in the way of our utilising many sources of diet at present despised on account of that dreadful "insular prejudice." And when we go abroad, is it not curious to see how readily we leave that uncomfortable appendage behind us? We "return to our muttons" at home, having enjoyed our travel, and having none the less enjoyed the horseflesh, and other comestibles pronounced delicious and savory, and all because (lamentable to relate) we didn't know what we were eating.

Artificial Honey

does not sound highly appetising, but as we hear it possesses all the delicate flavour and nourishing properties of the genuine article, it is likely to prove a serious rival to the natural product of the bee. It is called "sugar honey," and consists of water, sugar, a small proportion of mineral

salts, and a free acid. Herr T. Weigle brought the subject before a recent meeting of the Bavarian Association ofte Representatives of Applied Chemistry.

Our Fogs

appear to have vanished altogether for this season, as far as London is concerned, although there is every reason to believe that the disagreeable winding-sheet that so recently enveloped our city is now gaily careering about somewhere else. Borne on the wind, it may be at this moment striking terror into the hearts of some of our gallant seamen, or, before its final dispersement, endeavouring to stifle a whole village on the other side of the ocean. An instance of how sooty matter in mixture with vapour will disappear in one part and descend in another part of the country may be found in the annals of the city of Montreal. On November 9th, 1819, the city was suddenly enveloped in darkness, and rain as black as ink began to fall. Some of the liquid collected and forwarded to New York for analysis was discovered to owe its inky hue entirely to soot. The explanation of it was that there had previously been immense forest fires south of the Ohio river, the season being remarkably dry, and the sooty particles from the conflagration had been conveyed by strong winds northward, so as to mingle with the rain when it fell.

The Gorilla

forms the subject of an interesting article in another column. We have observed several interesting traits about young gorillas not referred to by our contributor. These intelligent creatures have been found very tractable in confinement. There was one in the Berlin Aquarium a few years ago which was remarkably human in its ways. It slept in an ordinary bed, covering itself with the bed-clothes, and ate at the table of the keeper, sitting in a chair and partaking of the ordinary food of the family. It ate with its fingers, never taking more than a decent morsel at one mouthful, and would drink water from a glass, carrying it steadily to its mouth without spilling, and setting it down carefully. Of cakes and other goodies it was very fond, and it would steal them from the cupboard most artfully, closing the cake-box and the door of the cupboard after executing the theft. It died of consumption in 1877. This complaint seems invariably to carry off gorillas and chimpanzees when they are confined or domesticated.

Another Human Similarity

about the gorilla is the fact that the coarse black hair which covers the gorilla becomes grey in age, and this fact formerly caused a mistaken belief to the effect that there were two species. It is said that the animal will assail the elephant and drive it away by striking the latter's trunk with a club, knowing that to be the sensitive point of the proboscidian. Probably the gorilla would be a fair match in strength for a lion, supposing that it came to a match between them; but there are no lions in gorilla land. The gorilla has thirteen ribs on each side, whereas a man has only twelve; it has also one more vertebra in its backbone than man has. Philosophers have been disposed to attribute the progress of mankind beyond the anthropoids to his possession of a serviceable thumb, upon which all his ability for manipulation mainly depends. Many of the great apes have most human-like hands, save for the thumb, which is not nearly so well developed and lacks certain important muscles. For example, a gorilla cannot perform the operation known as "twiddling." His muscular strength, however, equals that of at least half a dozen of the most powerful men. The capacity of his chest cavity is more than one-third greater than that of a man, which contributes enormously to his endurance. The rudimentary tail found in anthropoid apes not infrequently occurs with human beings, and this development is said to be hereditary among the Niam-Niams of Central Africa, and also among the Southern Malays. As for the prehensile foot, anatomists have called attention to the fact that the foot of a young baby has power to grasp, and is often used to pick up and hold objects very firmly.

Biting the Finger-nails

is a prolific cause of death, according to a medical correspondent. On one occasion, at a post-mortem, he observed the entire coating of the stomach bristling with bits of finger-nails. Apart from the physiological phase of this subject, it is anything but pleasant to see persons gnawing at the ends of their fingers. It is said that this habit indicates a bad disposition; but our observation leads us to believe that it is quite as likely to accompany nervous conditions as any defect in the temper. The habit is comparatively easy to break off if one goes at it in the right way. A middle-aged patient after having bitten her nails for almost her entire lifetime, broke herself of the habit by beginning on one finger. This she persistently left alone and carefully cultivated the finger-nail, giving a certain amount of attention to it every day. When this finger-nail had grown to the usual length she took up another, and so on, until all her nails except one were in perfect shape. It took months of the most persistent effort to break up the last remaining scrap of this tenacious practice. She said that she thought it was actually the greatest struggle of her life. The habit had become so fixed, that after days of abstinence from even a single nibble she would find herself almost viciously gnawing away at the poor little finger, but after awhile the effort was a success, and, although her hands never regained their symmetrical shape, they were vastly improved, and her health, which had been seriously affected, improved also. She had for years been subject to indigestion and kindred difficulties, but they almost entirely left her. She could not be pursuaded to believe that the breaking up of the habit of biting her finger-nails had anything to do with her improved health, but our medical correspondent always entertained a very decided opinion on the subject.

The Tenacity of Fish to Life

is one of the most remarkable phenomena of nature. Every angler has come across instances where fish have lived for years with wounds that it could hardly be believed could have been otherwise than fatal. A whaling barque that returned from the Arctic a few weeks ago took a monster whale, known as a "bowhead," that yielded 2,450 pounds of bone and several hundred barrels of oil. As a rule "bowheads" only yield from 1,400 to 1,800 pounds of bone. During the operation of stripping off the blubberthe spade, manipulated by the man doing the cutting, struck a hard, unyielding substance, which, on being exposed, proved to be the iron shaft of an old-style harpoon. The find was soon drawn from its fleshy sheath and passed on board, where it was examined with much curiosity by the crew. It was about three and a half feet long, with a slender shaft between its broad barbed point and the pole socket. Deep in the shaft, at its junction with the barb, was found stamped the name J. B. Morse. The J. B. Morse was the name of an old-time whaler that cruised in the Arctic half a century ago. So for fifty years this gigantic member of the *Mutilates*

must have been defying the elements with three and a half feet of steel buried in its back.

The Ether

has been engaging much scientific attention of late, much to the disgust of Mr. Edison. Here is his latest utterance on the ether:—"As for the ether which speculative science supposes to exist, I don't know anything about it. Nobody has discovered anything of the kind. In order to make their theories hold together, they have, it seems to me, created the ether. But the ether imagined by them is unthinkable to me. I don't say I disagree with them, because I don't pretend to have any theories of that kind, and am not competent to dispute with speculative physicists. All I can say is my mind is unable to accept the theory. The ether, they say, is as rigid as steel and as soft as butter. I can't catch on to that idea. I believe there are only two things in the universe," he goes on, "matter and energy. Matter I can understand to be intelligent, for man himself I regard as so much matter. Energy I know can take various forms and manifest itself in different ways. I can understand also that it works not only upon, but through matter. What this matter, what this energy is, I do not know." Vital energy is still a greater puzzle to him, and he believes that until we can, like nature, "make electricity out of the disturbed air the more delicate task of manufacturing vital energy, so that it can be bottled and sold at the family grocery store, will have to be deferred." By the way, an esteemed American correspondent considers that we did Mr. Edison a great injustice in our first issue in ranking him with adapters of principles rather than with discoveries of causes. Far be it from us to detract from Mr. Edison's greatness. We consider him one of the most eminent and painstaking *inventors* the world has ever produced, but we do not know of any first cause or principle that he has ever made known to humanity. We have dealt with Mr, Edison's views more fully in another column.

Derelict Vessels

and cargoes to the value of nearly half a million are said by competent maritime authorities to be floating about in the Atlantic at the present time. Some of these vessels have unsinkable cargoes, and, unless blown up or burned, or towed into port, will long continue to be dangerous obstacles on ocean highways. Many American wrecking tugs are now cruising for the derelicts nearest the Maine coast. The least of them would be a rare find for the wreckers.

A Marriage Custom

of a remarkably curious nature, is recorded by Dr. Post as existing in Southern India, among some of the more primitive non-Aryan tribes. It consists in wedding a girl to a plant, a tree, an animal, or even to an inanimate object, the notion being that any ill-luck which may follow an actual marriage will be averted by a union of this kind. The first "husband" acting as a scapegoat for the second, the superstition which forbids the younger sisters to be married before the older ones is set aside by the eldest daughter marrying the branch of a tree, after which number two may safely enter into the bonds of matrimony.

An Interesting Calculation

is involved in the method usually employed to measure corn in ears. Two cubic feet of sound, dry corn will make a bushel of shelled corn. To get the quantity of shelled corn in a crib or box of corn in the ear, measure the inside length, breadth, and height of the crib; multiply the length by the breadth, and the product by the height, to get the capacity in cubic feet; then divide the product by two. A bushel measure contains a very small fraction less than $1\frac{1}{4}$ cubic feet. Therefore, to ascertain the number of bushels of corn in the ear in the crib or other receptacle, divide the number of cubic feet which the receptacle contains by $1\frac{1}{4}$.

Athletic Lungs

is a medical term used to designate the abnormal development of lung possessed by some athletes. The condition is produced by those forms of exercise that call for the constant use of the lungs at their highest power. The result is an enormous development of lung capacity. Such men, upon giving up their active athletics and taking to sedentary pursuits, are peculiarly subject to pulmonary complaints. The over-developed lung is only used in part, and the unused cells usually fall a prey to disease when once an athletic lung has been restored to health. The term "athletic heart" is applied to a similar condition of the heart produced by like causes.

A Chemical Plating Process

has, it is claimed, been invented by Mr. F. W. Hayward, a watchmaker of Norwich. Mr. Hayward claims that his compound, which is perfectly harmless, is not a mere preparation of mercury, but one which leaves a deposit of sterling silver on all articles of brass, copper, etc., on which it is used. The inventor asserts that by means of a secret chemical process, he has been able to combine in the form of a powder, real sterling silver with other ingredients, which can be applied by anyone to give a practical and wearable coating of silver. Mr. Hayward has obtained provisional protection for his process, which should prove of immense value, if it can be proved by test of time to bear out all that is claimed for it.

If a Hole were Bored right Through the Earth

at its centre, and a ball were dropped into it, writes a correspondent of an inquiring turn of mind, would the force of gravity carry the ball beyond the centre? Our reply is that the momentum would carry the ball in its first flight past the earth's centre, but that it would ultimately come to a rest at that point.

The Smallest Screws in the World

are used in the production of watches. Thus, the fourth jewel wheel screw is the next thing to being invisible, and to the naked eye it looks like dust; with a magnifying glass, however, it is seen to be a small screw, with 260 threads to the inch, and with a very fine glass, the threads may be seen clearly. These screws are 4-1000ths of an inch in diameter, and the heads are double. It is estimated that an ordinary lady's thimble would hold 100,000 of these screws. No attempt is ever made to count them, the method pursued in determining the number being to place 100 of them on a very delicate balance, and the number of the whole amount is determined by the weight of these. After being cut, the screws are hardened and put in frames, about 100 to the frame, heads up, this being done very rapidly by the sense of touch instead of sight, and the ends are then polished in an automatic machine, 10,000 at a time. The plate on which the polishing is performed is covered with oil and a grinding compound, and on this the machine moves them rapidly by reversing their motion.

THE PRIZE SCIENCE SIFTING.

We have awarded the prize of One Guinea to Mr. A. R. HINKS, 23 Tavistock-road, Croydon, for the leading "Science Sifting." The other siftings published all deserve honourable mention.

The Satellites of Mars.

THE inner satellite of Mars is unique among the satellites known to astronomers, inasmuch as it performs its revolution round the planet in 7 hours 39 minutes 14 seconds, thus performing more than 3 revolutions per martial day. No other case is known of a satellite revolving in less time than it takes its primary to turn on its axis, and until Prof. Asaph-Hall discovered this case in 1877 it would have been deemed impossible. Prof. Ball in his "Story of the Heavens," mentions a peculiar coincidence in connection with this. In "Gulliver's Travels" we are told that the astronomers on board the flying island of Laputa had keen vision and good telescopes. Gulliver announced that they had found two satellites to Mars, one of which revolved round Mars in 10 hours. The author has not only thus guessed correctly the number of satellites, but he actually stated the periodic time of one with considerable accuracy. We do not know what can have suggested the latter guess. A few years ago any astronomer reading the voyage to Laputa would have said this was absurd. Yet the truth has been even stranger than fiction.

The Motion of a Bicycle-wheel.

IF a rapidly moving bicycle-wheel be photographed instantaneously, the spokes of the lower part of the wheel are given distinctly, but the spokes of the upper part are obliterated owing to the greater rapidity with which they are moving. All parts of the circumference of a wheel revolving on a stationary axis, move at the same rate. The case is different, when the axis moves forward in a straight line. Ignore the centre of the wheel. Consider the perpendicular diameter. One extremity is at the highest point of the wheel, and the other touches the ground. When the wheel begins to move, this diameter swings on the lower extremity as a centre, in fact for an indefinitely short time, it becomes a revolving radius with a fixed end on the ground. The upper end being further from this momentary centre, it revolves more quickly than the lower. The motion of the wheel is made up of a rapid succession of these swings, on succession perpendicular diameters—the successive parts of the circumference becoming centres as they touch the ground. Similarly, each point of the circumference has its turn of quickest motion, when it is furthest from the ground.

G. Horsfall, Saxmundham.

A Dark Planet.

FOR a long time, there has been a controversy amongst astronomers, if there is not a dark planet, "one that appears not to reflect the sun's rays," going round the sun, close to him. The following may perhaps help to solve this difficulty as regards light. Place in a row, a large electric light, a sun gas burner, best paraffin lamp, a candle, a lucifer, and a herring, light them all except the last, and place in sunlight, their light appears to go out and their flames give a sickly glimmer. Shut off sun power, and the eyes are painfully dazzled by the electric light; and so on, shutting out the light of each, until you come to the herring. Now shut your eyes so as to ensure complete darkness for one minute, take the herring and lay it across a newspaper, and you can read by its light. Take away your sunlight, and this supposed dark planet may be brighter than Venus at its best. Also it is possible, if a darker darkness could be found, the darkness of night would appear light. It may be, that lions and tigers are able to see so well in the dark, because they live in deep caves, which are darker than the night atmosphere outside. Anyone who likes to take the trouble can test this. Take any intensely foggy day, say near Charing Cross Underground Railway. As you enter the station it is perfect blackness all around, the gas lamps appearing as sickly flames. Go downstairs on the platform, and look upwards, and you will find what was darkness outside, appears light overhead.

E. Kennedy, 16, Eversleigh-road, Lavender Hill, S.W.

The Steam Engine and the Human Body.

The steam-engine in action takes :—	The animal body in life takes :—
1. Fuel, viz., coal and wood, both being old or dry vegetable matter and both combustible.	1. Food, viz., recent or fresh vegetable matter and flesh, both being of kindred composition and both combustible.
2. Water.	2. Drink (essentially water).
3. Air ;	3. Breath (common air) ;
and produces :—	and produces :—
4. Steady boiling heat of 212 deg. by quick combustion.	4. Steady animal heat of 98 deg. by slow combustion.
5. Smoke from the chimney or air loaded with carbonic acid and vapour.	5. Foul breath from the wind pipe, or air loaded with carbonic acid and vapour.
6. Ashes, part of the fuel which does not burn.	6. Animal refuse, part of the food which does not burn.
7. Motive force, of simple alternate push and pull in the piston, which, acting through levers, joints, bands, etc., does work of endless variety.	7. Motive force, of simple alternate contraction and relaxation in the muscles, which acting through the levers, joints, tendons, etc., of the limbs, does work of endless variety.
8. A deficiency of fuel, water, or air first disturbs and then stops the motion.	8. A deficiency of food, drink, or breath first disturbs and then stops the motion and the life.
9. Local drainage from violence in a machine is repaired by the maker.	9. Local hurt or disease in a living body is repaired or cured by the action of internal vital powers.

John Edwards, 43, Calvert-road, East Greenwich.

IMPORTANT ANNOUNCEMENT.

With our next issue we intend starting a column for "Science Queries and Answers," and awarding a prize of two shillings and sixpence for every interesting question asked and published, and five shillings for every correct answer published. Questions asked by correspondents and not replied to by our readers, will, if of sufficient interest, be dealt with Editorially.

Rules for Competitors.—(1) Only one question may be sent each week, but any number may be answered. (2) Write on one side of the paper only. (3) Envelopes must be marked "Science Queries and Answers," and must arrive not later than the Monday following date of publication.

These Prizes are intended to take the place of the "Prize Science Sifting," which will accordingly be discontinued.

GLEANINGS OF THE GLOBE.

RICE forms the chief food of about a third of the human race.

IN British India twenty-eight million acres are cultivated by irrigation.

THE human brain weighs one thirty-fifth of the whole body.

THE art of sugar refining was first practised in this country in 1659.

TO effect the respiration of a carp, 13,300 arteries, vessels, veins, bones, valves, etc., are necessary.

DURING the 100 years' existence of the United States Patent-Office it has issued 453,944 patents.

THE National Museum of Brazil has come into possession of an enormous aerolite. It weighs 11,800 pounds.

HICKORY tires are coming into use for bicycles. They are easier on the rider than the metal, being more elastic.

THE orange was originally a berry, and its evolution has been going on for more than 1,000 years.

GREEN boughs of the eucalyptus tree are said to be among the best disinfectants known for a room where scarlet fever exists.

IN China all wines are drunk hot. The thrifty Chinaman believes that heated wine intoxicates more expeditiously than cold wine.

THE earth is gradually growing larger from the fall of meteoric matter. An astronomer estimates that the globe is annually pelted with 146,000,000 projectiles.

THE amount of food, liquid and solid, which the average man consumes in his seventy years, is calculated at no less than eighty tons.

THE value of straw as manure consists in its property of giving back with other substances a considerable proportion of silica, in that form which adapts it to the use of the succeeding crop.

IN this country winds are most prevalent in the following proportion out of a thousand days:—South-west 225, West 171, North-west 120, North-east 111, South 111, East 99, North 82, and South-east 81.

THE Custom-house agent in Duisburg assessed a collection of butterflies as "poultry," for the reason that they had wings; and it required much time and patience to get the collection passed free as an object of science and art.

BARNUM, in his time, engaged several expert mechanicians to construct perpetual-motion machines for him. It was then his delight to hear the various erroneous explanations of the movements offered by other cranks in the same line.

SPIDERS find engineers' plumb-lines in tunnels, etc. excellent hatching-places for webs, to the great annoyance of the experts. Fine meter work has also been interfered with in the same way.

IN China the planters cultivate the tea plant by digging a hole into which they put a handful of seeds. In Assam they plant the seeds on small ridges of earth and cover them over.

A PHILOSOPHICAL statistician calculates that in the year 2000 there will be 1,700,000,000 people who speak English, and that the other European languages will be spoken by only 500,000,000 people.

THE strength of spider silk is incredible. Size for size it is considerably tougher than a bar of steel. An ordinary spider thread is capable of bearing a weight of three grains, while a steel thread of the same thickness would support less than two.

IT has been calculated that the electromotive force of a bolt of lightning is about 3,500,000 volts, the current about 14,000,000 ampères, and the time to be about $\frac{1}{20000}$ part of a second. In such a bolt there is an energy of 2,450,000,000 watts, or 3,284,182 horse-power.

THE floods on the Ohio and Mississippi created a large demand for barbed wire. It was used in making "mattresses" to hold the earth steady in the shifting channels. The manufactures of barbed wire are "getting together" and will soon form some sort of a trust.

A RECENT discovery of old English weights and measure includes the two standard yards of 1,758 and 1,760, supposed to have been destroyed by fire in 1834. The most important missing weight—the standard troy pound—is not among those now brought to light.

WHEN a forest is destroyed by fire, it has been observed that the trees which grow afterwards are unlike those that the fire consumed, and evidently arise from seeds that have long lain buried in the earth, waiting the time when the ascendency of the reigning order of plants should cease.

BELGIAN railway officials, after three years of investigation, report that under ordinary circumstances the average railway train in passing over one mile of track wears from it two and one-fifth pounds of iron. This destruction of track amounts for the whole world to about 1,330,000 pounds daily.

A VISIONARY claims to have invented an apparatus through which, he declares, he can see the soul leave the body. He arranges lenses that so magnify the particles of dust in the air that their disturbance by anything passing upward can be detected. How he is to see those souls that pass downward is not explained.

"THE Week's News" is a periodical that has been recently projected to meet the demands of those busy folk who are unable or unwilling to select for themselves the chief items of interest in the daily and weekly press. It publishes these at the end of every week in condensed and readable form, and from the appearance of the numbers we have already seen, we should imagine that the paper fulfils its mission admirably.

PRIZE ARTICLE.

THE CONDITION OF MAN IN 1991.

One Hundred Years Hence.

It would be impossible, within the prescribed limits, to trace, even in the most cursory manner, the operations of more than one of those great influences by which the conditions of human life are subjected to material and continuous modification. The forms of government tend, it may be hoped, to adapt themselves to conditions permitting greater personal liberty. Beyond this, however, any political or even social forecast must rest on premises of a highly controversial character. And, perhaps, it might be added that such political changes as can be expected to occur during the next century, will prove to be matters of little consequence, comparatively speaking, to the large majority of mankind. With hardly an exception, even in favour of a "north-west passage," geographical discoveries, such as to change the course of international commerce, are not any longer possible. The probable increase in the population of the world is a subject of more importance in respect of this inquiry, but it is far too complex a matter for discussion in a popularly interesting form.

What is it that, in the century before us, will affect man's power and condition in the most strongly-marked manner? Surely the development and commercial application of scientific knowledge. At least, in the past century the influence of physical science has been supreme; and, owing to the certitude with which many of its future achievements can be predicted, and to the confidence with which others, dependent, perhaps, on forces not yet known, can be expected to surpass all that it has entered into our mind to conceive, there is probably no other agency, by which the courses of human affairs are controlled, that is equally suited for discussion in SCIENCE SIFTINGS. It is noticeable, at the present day, that an increasing section of the public is entering on the study of science, for the sake of its valuable aid in the practical arts. Many of the most important inventions have been made by workmen. And it is worth remarking that, as the production of mechanical energy is cheapened and facilitated, the necessary hours of workmen's labour must be reduced. And so the "eight-hours day" of the nineteenth century will become unnecessary legislation. With more leisure for improvement of the mind, and with lower taxes on invention than are imposed by existing patent systems, we may anticipate, for the not distant future, a more rapid rate of advancement, both in science and industry, than has ever yet been known. And we may reasonably conclude that our descendants, in the year 1991, will enjoy means of comfort and advantages that might appear to us, if we could see them, almost as inexplicable as our locomotives and telegraphs, our photographing, hearing and talking machines, would have been considered by our forefathers in the eighteenth century.

A guess at the state of industrial science in 1991, is, therefore, what is called for in reply to the question put by SCIENCE SIFTINGS. To merely enumerate the projects that occur to persons with some little scientific knowledge, upon turning their minds in the direction indicated, would be a very extensive undertaking. There are some predicted improvements in science to which a very high degree of probability attaches; others, more doubtful, are still worthy of consideration, while it can be said of the most fanciful flights of a scientific imagination that, at least, they cannot seem to be more visionary than many of our most commonplace accomplishments would have been deemed in ages past. It will only be possible to mention here a few of the more striking suggestions that first present themselves in this connection, and, first, as to the noble art of war. Assuming this to be a necessary evil, it is, however, one for which there is a prospect of amelioration, in proportion to the fulness of control acquired over its machinery by scientific means. The whole character of warfare seems to be undergoing change, and it may be hoped that the final tendency of this change will be to reduce the number of men exposed in action, while increasing the complexity of the mechanisms and munitions of war. In such a case the brunt of battle might fall rather upon dead mechanism than on living men. The army whose mechanical defences became shattered would be virtually defeated; and bloodshed, no longer a necessary concomitant, might become almost an accident of warfare. Other things being equal, the international quarrels of the next century will be decided rather by ingenuity in applying the principles of physical science than by mere brute strength. And this fact will secure the survival of the "fittest" governments, viz., those by which the importance of experimental research is recognised in the fullest and most practical manner. Mechanical kites and balloons, held captive by strands of insulated wires, should play important parts in the military operations of the future. To these, "automatic" range finders, with vertical base line, could be attached; also aerial "heliographs" for signalling between points that are separated by hills or similar obstacles. It will even be possible to convey from a suspended camera panoramic views of the underlying country. These views will be be transmitted to any distance by means, perhaps, of an electric current that varies rapidly in accordance with the several degrees of brightness at different parts of the picture. The appearance of optical continuity in the image at the receiving instrument will be due, in this case, to the very rapidity with which the electric impulses, giving rise to the different portions of it, succeed one another. The coalescence of all these ephemeral and partial images will be due, in fact, to the well-known phenomenon of "persistence of vision" on the human retina; and it could be further promoted by the employment, at the receiving instrument, of a film of phosphorescent material. We can understand, therefore, how commanders of armies in the twentieth century may be enabled to follow easily the movements of their brigades of smokeless artillery, although situated at great distances apart. And we may anticipate also that the telephones of a hundred years hence will transmit, not only the speech, but also an image of the user, and present it upon a suitable receiving surface, almost as clearly as in a looking-glass.

From the consideration of mechanical kites as applied to military purposes, it is an easy transition to the distinctly peaceful art of human flight. For it seems probable that sufficient gas, compressed air, or electricity could be conveyed by means of pipes or wires to furnish motive power in a captive "flying machine." If so, the conditions of human flight, with one exception, could be experimentally determined. This one exception—the highly concentrated store of available energy that is essential to free flight—appears to present great difficulty. It can hardly be doubted, however, that new and much-improved methods for the storage of force will be discovered in the course of the next century, and, therefore, it is confidently hoped that, ere its close, the brilliant feat of aerial navigation may have been accomplished. Of course, the mechanical propulsion of balloons suggests itself in this connection, but is, apparently, a scheme devoid of promise. Conceivably a sort of cross between, or combination of, a

flat-bottomed ship with a balloon, might skim over the surface of the sea with great rapidity, impelled by the wind and guided by an aerial propeller. It is doubtful, however, if even the temerity of a twentieth-century inventor would be equal to attempting such a dangerous voyage. Turning next to the progress of ocean navigation proper, we may be sure that much improvement in it will be made. At night-time, by the reflection of vibrational force, due warning will be given of the approach of other vessels, or of land. The depth of the water will be continuously recorded without the use of sounding-lines, in this case, perhaps, by the reflection from the bottom of a wave of sound. Light for signalling purposes will be largely replaced by radiations of slower period, which penetrate the densest fogs, and the "look-out" will be supplemented by an electric automaton.

Then, another important field for the application of increasing scientific knowledge will be found in the demand for an augmented food supply, created by the growth of population. Artificial light, heat, and electricity have all been employed successfully as stimulants to vegetation, and it is probable that when radiant and electric forces are developed with less waste than now, these agents may be used on a large scale in agriculture, to supplement the action of the solar rays. Again, meteorological forecasting will, of course, be better understood, and, if our American friends are to be believed, the rain supply will even be controlled. Chemical manures will be cheapened, and will not only be more extensively, but also much more intelligently used than now. Great works of hydraulic engineering, by which large tracts of barren land are made productive, will also be distinguishing features of "the good time coming." A hundred years hence the "smoke nuisance" will have ceased from troubling. For either gas, or fuel oil, or coke, can be completely and, therefore, smokelessly burned, if burned alone. It is only where these three forms of combustible matter are intimately associated, as in heated coal, that economical conditions of combustion are practically unattainable; and, therefore, the prevention of smoke and waste can be assured both simply and effectually by any method of coking or distilling coal that permits of recovering the liquid and gaseous bye-products. It is probable that liquid fuel will be mostly used in motors for land or marine locomotion. It possesses more potential energy than an equal weight of coal. But a still more universal change in motive power engines is foreshadowed by the fact that steam and steam boilers are essentially wasteful agents for the transformation of heat into work. In the near future, therefore, steam must go, and gas or air engines, according to the class of fuel available, will be employed for the production of mechanical force. Cheap oxygen, distributed in pipes like coal gas, will revolutionise existing methods of combustion. A small reduction, also, in the cost of extracting certain metals would be attended with great advantage; and to all these things improving technical knowledge is very quickly leading us. Even gold, our nominal standard of value, has been cheapened very much within the last few hundred years. And this not merely from the discovery of new ore mines, but as the result of applying more scientific methods to the reduction of the metal. If but a small proportion of the many million tons of gold and silver held in solution in the sea could be recovered, what a startling effect would be created on the money market! By industrial science the luxuries, and even the extravagances, of one generation are rendered subservient to the common enjoyment of all classes in the next. And we may easily suppose that in the year 1991 not even a "precious" jewel will be recognisable by skilled experts.

More substantial benefits will accrue, however, from railway travelling at 5 miles a penny; from penny telegrams; and trans-oceanic pipe lines, for the transmission of postal packets, or even passengers (as an American suggests) through pneumatic tubes; also from the distribution of electric power, cheaply developed in the simple combustion of coke; from the utilisation of tidal energy—the rotational momentum of the earth; and more than all, from the improvement of the physician's skill. When gravitational force has been brought under control, man will have power to interfere with the relative motions of celestial bodies. Giving free play to the imagination, we might further suppose that, in this case, vast stores of energy, drawn from the luminiferous ether, would be applied to the conveyance of "ether ships," or even the earth itself, on expeditions extending into other planitary systems!

ARTIFICIAL RAIN-MAKING.

Prof. Edwin J. Houston recently read a paper before the electrical section of the Franklin Institute under the above title.

"A circumstance that appears to have been lost sight of in all the recent attempts at rain-making," says Professor Houston, "is that such attempts have been apparently made regardless of the hygrometic conditions of the air As rain is but the excess of moisture, which the warm moist air when sufficiently cooled is unable to retain, the amount of the fall will depend, as already stated, on the quantity of moisture in the air as well as on the extent of the chilling action following the explosion or other cause. To attempt to produce rain by explosions in mid-air, irrespective of the quantity of moisture in the air, is to attempt to cause water to fall from the air when practically none is present. This is not only illogical, but absurd.

"Though lightning is not a cause of rain, there can be no doubt that if rain can be artificially produced during a period in which there is much free electricity in the air, the storm will be attended by lightning and thunder. If, then, there be any increase of rain due to the presence of lightning, artificial rain-making will be more liable to succeed when the potential of the air, as regards the earth or neighbouring clouds, is comparatively high.

"The following general conclusions may, in view of the present state of meteorological science, be properly drawn concerning the artificial production of rain:

"(1) That rain can never be made to fall at will by mid-air explosions on any part of the earth's surface, irrespective of the climatic conditions there existing.

"(2) That during certain meteorological conditions, mid-air explosions may result in rainfall over extended areas.

"(3) That the liberation of energy necessary for such rainfalls is due not to the mid-air explosions, but to the energy stored up in the moist air from which the rain is derived.

"(4) That the meteorological conditions which must exist for the successful action of mid-air explosions would probably, in most, though not in all cases, themselves result in a natural production of rain.

"(5) That a comparatively high difference of electric potential between different parts of the air, or between the air and the earth, is possibly favourable when taken in connection with other meteorological conditions for artificial rain-making.

"(6) That an undirected mid-air explosion is not as likely to produce rain as an explosion in which the main tendency of the energy liberated is to cause a general uprush of the air."

HOW TO REST.

The value of rest as a therapeutic or curative agent has been much insisted upon in recent years, and there can be little doubt of its great utility in an age of such strain and excitement as that in which we live. There are many persons who need nothing so much as simply to lie fallow for a little, to let tired nature have some chance to recuperate and to repair the waste which goes on so continuously. The difficulty, according to the *Lancet*, is to obtain the conditions under which rest of the right kind is practicable. Some change of environment is usually needed, our contemporary tells us, as without it relaxation of care and excitement is hardly possible. It is here that some varieties of travel find their best application. Travel is too often the reverse of restful, and there are cases in which we seek in travel, not rest, but distraction, change, mental stimulation. We may perhaps advantageously inquire what kinds of travel, what plans and precautions, are applicable in a case where we desire to combine rest with change of scene and moderate mental stimulus.

The first variety that suggests itself for this end is the sea voyage. It combines the following great advantages—continuous life in a pure and invigorating atmosphere, constant passive motion without any fatigue, change of scene, novel conditions of life, freedom from cares, worries, and excitements, mental and physical rest. These are very important points, and there can be no doubt that the sea voyage deserves a high place among the varieties of means of treatment by rest. There are, of course, the drawbacks of sea-sickness, separation from home and friends, possible bad weather, and of some slight risk. None of these points are, however, formidable drawbacks to the recommendation of the sea voyage in a suitable case of the kind under consideration. The patient who seeks the benefits of rest on shipboard must sedulously shun one snare—viz., imprudence on landing. He must not prematurely resume habits of activity after the luxurious rest of a voyage through the summer seas of tropical regions. There is one form of voyage peculiarly applicable in many cases where we desire to combine rest with travel—we mean the voyage from Cairo to the Nile cataracts in a "dahabiyeh," or Nile steamer. This voyage can be performed with all the accessories of luxury, in one of the most perfect climates in the world, and through a country abounding in interest to the scholar and antiquarian. The season is from November to March, and continuous sunshine may be reckoned upon as soon as Luxor is reached. The trip from Cairo to Assouan and back can be made by steamer in three weeks. The dahabiyeh is, of course, at the command of its occupants, and several months may be thus spent with great advantage. For those who desire some distraction, visits can be arranged to many interesting ruins, and some sport may be obtained. The cost per head of a voyage by dahabiyeh is reckoned at twenty-five shillings per diem. The only drawback to the almost perfect character of the climate is that it is sometimes very cold at night.

Another region worthy of note, as presenting the conditions desirable in the combination of travel and rest is the Algerian verge of the Great Sahara Desert. There are various oases, of which Biskra is perhaps the best known, now accessible by rail from the seaports of Algeria, where the continuous sunshine, the profound calm of the desert, and the "far off-ness" from the rush and strain of modern civilisation, make a combination of great utility in certain cases. Here, again, we have to enumerate some inevitable drawbacks. The accommodation in these cases is bad, though improving; the journey from the coast is performed very slowly and uncomfortably, and dust-storms are occasionally troublesome Yet it is not improbable that ere long a month or two on the edge of the Sahara will be a familiar resource to those who want to escape from home cares and to breathe a perfectly new and unfamiliar atmosphere.

The mountains offer another resource to the class whose needs we are considering. As regards purity of air, perfect calm, and relief from excitement, the mountain stations are comparable to the desert sanatoria. They are, however, much more stimulating, and hence are unsuitable for cases in which we desire a sedative rather than a stimulant effect. The influence of the elevated sanatoria upon cases of nervous breakdown, now so large a factor in practice, is a subject that has not yet been thoroughly worked out. Where there is much irritability, marked dyspepsia, and obstinate insomnia the mountains are generally, and probably justly, held to be injurious. But there is a large class in which these symptoms are less strongly marked, and for these a moderately stimulating atmosphere will sometimes be found beneficial. To determine whether the mountains will suit one of these cases is like the problem of deciding whether, in a given case of nervous debility, strychnine will exercise a tonic or only an irritating effect. Everything depends upon the general balance of symptoms, and upon the insight of the physician. The mountains may be recommended to those desirous of rest, either in summer or winter. The sheltered resorts will naturally suggest themselves, and care will be needed to avoid those where fashionable gaiety unduly prevails.

Travel as a therapeutic agent is in some danger of being discredited owing to its fatigue. It is imperative that the invalid shall not exhaust his feeble store of vitality by long and exhausting journeys. The arrangements for travelling are now generally so good in most civilised countries, that there is less excuse than formerly for errors of this nature, and it may be hoped that the perfectly practicable combination of travel and rest will more and more be successfully attained.

SIFTINGS OF THE STUDY.

"Lantern Slides, and How to Make Them."

By A. R. Dresser.

This is the title of a most useful little manual published by the Fry Manufacturing Co., of 5, Chandos-street, Strand. The book deals thoroughly with the making of lantern slides which amateur photographers now find so absorbing a branch of their hobby. For all interested in the production of lantern slides it is a veritable *vade mecum*, and the subject is dealt with in a masterly fashion. The present revised edition is the second published, and the fact that 15,000 copies have actually been sold in twelve months speaks volumes for the popularity of the work. The author is known as one of the most expert amateur photographers, and it may interest our readers to know that he is a brother of Mr. Dresser, the well known zoologist and author of some valuable works on ornithology. The manual is published at the wonderfully low price of sixpence.

Black glass and black mica which are nearly opaque to light are transparent to heat to the extent of 90 degrees out of a hundred; pale green glass, coloured by oxide of copper and covered with a coating of water or a thin coating of alum will be perfectly transparent to light, but will be almost opaque to heat.

VITAL ENERGY AND ELECTRICITY.

Mr. Thomas A. Edison has spoken his mind, touching energy, as follows:

"Of course there is a source of energy. Nature is a perpetual motion machine, and perpetual motion implies a sustaining and impelling force.

"When I was in Berlin I met Du Bois Reymond, and, wagging the end of my finger, I said to him, 'What is that? What moves that finger?' He said he didn't know; that investigators have for twenty-five years been trying to find out. If anybody could tell him what wagged this finger, the problem of life would be solved.

"There are many forms of energy resulting from the combustion of coal under a boiler. Some of these forms we know something about in a practical way, but there may be many others we don't know anything about.

"Perhaps electricity will itself be superseded in time, who knows? Now a beefsteak in the human stomach is equivalent to coal under a boiler. By oxidation it excites energy that does work, but what form of energy is it? It is not a steam pressure. It acts through the nerve cells, performs work that can be measured in foot pounds, and can be transformed into electricity, but the actual nature of this force which produces this work—which makes effectual the mandate of the will—is unknown.

"It is not magnetism; it doesn't attract iron. It is not electricity—at least not such a form of electricity as we are familiar with. Still, here it is necessary to be guarded, because so many different forms of electricity are known to science that it would be rash to say positively that we shall not classify vital energy as a form of electrical energy. We cannot argue anything from difference in speed. Nerve force may travel as fast as electricity, once it gets started. The apparent slowness may be in the brain. It may take an appreciable time for the brain to set the force going.

"I made an experiment with a frog's leg that indicates something of the kind. I took a leg that was susceptible to galvanic current. The vibration produced a note as high as a piccolo. While the leg was alive it responded to the electrical current; when it was dead it would not respond. After the frog's leg had been lying in the laboratory three days I couldn't make it squeal. The experiment was conclusive as to this point: The vital force in the nerves of the leg was capable of acting with speed enough to induce the vibration of the diaphragm necessary to produce sound.

"Certainly this rate of speed is much greater than physiologists appear to allow, and it seems reasonable that there is a close affinity between vital energy and electricity. I do not say they are identical; on the contrary, I say they are very like. If one could learn to make vital energy directly without fuel, that is, without beefsteak in the stomach, and in such manner that the human system could appropriate it, the elixir of life would no longer be a dream of alchemy. But we have not yet learned to make electricity directly, without the aid of fuel and steam.

"I believe this is possible; indeed, I have been experimenting in this direction for some time past. But until we can learn to make electricity, like nature, out of disturbed air I am afraid the more delicate task of manufacturing vital energy, so that it can be bottled and sold at the family groeery store, will have to be deferred.

"Electricity, by the way, is properly merely a form of energy, and not fluid. As for the ether which speculative science supposes to exist, I don't know anything about it. Nobody has discovered anything of the kind. In order to make their theories hold together, they have, it seems to me, created the ether. But the ether imagined by them is unthinkable to me. I don't say I disagree with them, because I don't pretend to have any theories of that kind, and am not competent to dispute with speculative scientists. All I can say is, my mind is unable to accept the theory. The ether, they say, is as rigid as steel and as soft as butter. I can't catch on to that idea.

"I believe that there are only two things in the universe—matter and energy. Matter I can understand to be intelligent, for man himself I regard as so much matter. Energy, I know, can take various forms and manifest itself in different ways. I can understand also that it works not only upon, but through, matter. What this matter, what this energy is, I do not know.

"However, it is possible that it is simple matter and energy, and that any desire to know too much about the whole question should be diagnosed as a disease; such a disease as German doctors are said to have discovered among the students of their universities—the disease of asking questions."

CHANGE THE COURSE OF THE SHIP.

A thief and a liar can be endured, because one can not be perpetually lying or stealing; but the man who was born with a spirit of argument in his composition follows the business of arguing continually. You can not risk saying that the grass is green, or that a rat's tail is longer than a mouse's without being contradicted and challenged to prove your statement. He will discuss the subject pro and con to show you that you are in error, and if you don't see it he will insinuate that some folk are intellectually blind, and then your temper will rise and his likewise, and you will say something hot, and so will he, and there will be "trouble in camp." When it comes to married life it is safe to say that two-thirds of the divorces are caused by argument. People who do not argue seldom appear in divorce courts. It has been said over and over again that no two persons can be found who agree upon every point, and probably it is a true assertion. Nor is it necessary that they should. Peace and order can be preserved in a house by forbearance and tolerance, even if one member of the household insists that black is white and another member is sure white is black. We should always be willing to grant freedom of thought and belief to others. Two persons who are associated together will before long discover that there are points upon which they always disagree, and these subjects should always be avoided in conversation. They are rocks upon which many a bark of happiness has been wrecked. Change the conversation whenever you find it drifting towards these fatal channels, just as you would change the course of a ship if you were a pilot and saw gleaming in your course the warning buoy attached to a sunken reef. Whenever it can consistently be done it is best to avoid the man who argues. It is extremely unpleasant to feel that you are in the witness box of cross-examination and to be obliged to prove your simplest propositions by all the ologies and isms known to science. Argument is in its place in lyceums and debates—sometimes in the pulpit—but not as steady diet among friends. It is the essence of contradiction; and the person who is continually contradicting will act like an east wind on peace and sociability. We think we could endure abuse, Billingsgate, and eggs which had passed through the chemical laboratory of decomposition, but from the man who argues, good Lord deliver us!

DIGESTION AND MICROBES.

An article of considerable interest has been written by Professor Kianowski in a German contemporary. It treats of the subject of the microbes of the stomach, and the effects of the gastric juice (the most important digestive fluid in the body) on them. The Professor undertook a series of observations on healthy persons, as well as on patients suffering from disease. The results at which he has arrived are as follows :—1. The quantity of bacteria found in the contents of the stomach one hour after a meal is not so much in inverse relation with the acidity of the gastric juice and the quantity of hydrochloric acid therein, as it is in direct relation with the amount and varieties of micro-organisms introduced with the food. 2. Within the limits of the mean acidity due to hydrochloric acid, the gastric juice systematically and completely kills the microbes in the stomach ; the more prolonged the action of the gastric juice, the more micro-organisms does it kill. 3. There is a general relation between the increase of the general acidity due to the normal or abnormal properties of hydrochloric acid on the one hand and the quantity of microbes destroyed on the other. 4. If the acidity of the gastric juice is feeble, the micro-organisms multiply in the stomach. 5. It is shown that if the gastric juice of patients contains a sufficient quantity of free hydrochloric acid, it possesses the same power of destroying the microbes as the gastric juice of healthy persons. The conclusions to which Kianowski came are briefly : 1. In a state of fasting the stomach of a man in good health contains a large number of micro-organisms. 2. The quantity of organisms existing in the stomach during the first hours of digestion is in direct relation with the numbers introduced with the food, drink, air, &c. 3. The gastric juice, and especially the hydrochloric acid, possesses strong microbicide properties. The micro-organisms probably take no active part in the processes of gastric digestion. 5. Persons who by reason of some disease secrete hydrochloric acid in small quantities only, more easily become the victims of poisoning by microbes or their products introduced into the stomach. 6. It is not well in the morning to remain too long a time fasting; and during epidemics, such as cholera, the stomach ought not to be allowed to remain empty for any length of time, and sterilised food, if possible, should be taken. Van Puteren in the *Deutsche Medicinische Zeitung* reports similar observations. The proportion of bacteria in the stomach was found to be greatly increased whenever the tongue was coated or deposits existed in the mouth. The bacteria were much more numerous in infants fed on cow's milk than in those nursed at the breast. After the mouth had been thoroughly cleansed, in 18 per cent. of the cases no micro-organisms were obtained from the stomachs of breast-fed children ; in 41 per cent. the proportion to the average number found in the stomach under the circumstances was as 1 to 130. The observations further showed that the acidity of the stomach did not prevent bacterial growth.

A GERMAN chemist has invented a preparation which, it is claimed, when applied to the soles of shoes, has the effect of increasing their wearing capacity from five to ten times, besides making them water proof. The preparation is applied after the shoes are finished and the soles are buffed. The right to use it has been sold to the Bavarian Government for the army. The inventor says it has been tested in the German army satisfactorily.

AN EXPEDITION TO GORILLA LAND.

Professor Garner's contemplated expedition to Gorilla Land is exciting profound scientific interest among zoologists. His learned friends are assisting him in the preparation of the most remarkable equipment ever carried by an explorer. Among other things, it will include phonographs, telephones, photographic apparatus, an electric telegraph, and a complete taxidermist's outfit. There will be a big cage, 8 feet cube, which the traveller himself intends to occupy ; also a small cage to hold a gorilla, in case one is captured alive. The armament to be taken along for offensive and defensive purposes will be altogether extraordinary and of a character unheard of hitherto. The expedition will enter the mouth of the Gaboon River, just under the equator on the west coast of Africa, and, having secured an escort of natives, will proceed up the stream for a distance of 112 miles. At that point the first of a series of cataracts and rapids is reached, and there the party will disembark, plunging southward into the tropical forests of the gorilla country. A locality that is particularly infested by these giant apes will be sought, and there, in the midst of the howling equatorial wilderness, the Professor will set up his cage. He will occupy it alone, at night as well as in the daytime, being merely connected by a telephone wire with the rest of the party, which will be located at a distance of half a mile or more. It is necessary for this purpose that the animals whose language he is desirous of studying should be disturbed in their native haunts as little as possible. His conversations with them will be solitary dialogues, unless, perchance he should be so fortunate as to secure the presence of several gorillas at once around his barred inclosure.

The cage will be constructed in New York. It is to be made of aluminium, for the sake of lightness, and will be built in eighteen sections. Thus it can be carried very easily. All of its joints will lock automatically when it is set up. The floor will be of rubber. Strong steel chains will fasten it to the ground, lest any gorillas should take a notion to walk away with it. Every possibility of attack, however, if sufficiently provided against in other ways. A powerful electric battery will be so arranged that by the touch of a button the entire cage, save only the rubber floor, will be instantaneously charged with electricity. If Prof. Garner sees any hostile and dangerous creature approaching, he will merely have to press the button, and the electric fluid will do the rest. The fierce gorilla—supposing such a case—upon grasping the bars, will receive a shock of 500 volts. This is enough to kill a man, who is able to survive a more powerful stroke of such lightning than any other animal.

Recourse would not be had to such a means of defence unless it were absolutely necessary, because the Professor's object is to cultivate friendly relations with the gorillas, and not to injure them. But these huge apes are said to be the most dangerous and ferocious creatures in existence, invariably attacking men on sight, and so it is as well to be prepared. At a short distance from the cage, on all sides, will be extended copper wires, arranged in such a manner that they can be drawn taut at about 2 feet from the ground at a moment's notice, though ordinarily they simply slack in the grass. Suppose that a whole troop of fierce animals, enraged by the presence of the cage and its occupant, should make a rush to destroy the one and capture the other. Then the bold scientist would touch a button, the wire barriers would spring taut all around him, and the foes upon touching them would be knocked *hors de combat* by a tremendous shock of electricity. The battery will be powerful enough to sustain in the cage a voltage of 500 volts for thirty minutes, which

is likely to be sufficient for all purposes.

Some curiosity has been expressed as to the means by which Prof. Garner will attract the gorillas to his cage in order to interview them. He does not anticipate any difficulty about that. In the first place, these animals are so aggressively disposed that they may approach him of their own accord for that reason. Again, their curiosity is likely to draw them. But reliance is had for the purpose upon certain devices. Effigies resembling human beings or gorillas, or both, will be constructed and placed in natural attitudes near the cage to serve as decoys. Every one knows how fond all monkeys are of looking at themselves in the glass, and this weakness of theirs is to be taken advantage of. Large mirrors, to be taken along with the outfit, will be set up outside the cage, and any gorillas which catch sight of themselves in these looking-glasses will presumably be induced to stay and make remarks concerning their own personal appearance. Besides all this, the Professor hopes to excite the interest of the beasts by learning the meanings of their varied howls and responding to them himself as seductively as possible. Fruit, too, upon which gorillas depend chiefly for their diet, will be scattered about for bait.

Having induced the gorillas to come near the cage, when they will doubtless have plenty of observations to make in their own language, the next thing requisite is to record what they say. This will be done by means of a phonograph which Mr. Edison is now making expressly for the purpose. It will be different from any other phonograph ever seen. For one thing, it will have two cylinders, which will be worked simultaneously by an electric motor, one cylinder receiving and recording sounds, while the other one grinds out remarks. The object of this is readily explained. Suppose that the gorilla comes up to the cage and utters a lot of what seems like gibberish, the horn attached to the instrument absorbing it and a revolving cylinder taking it down. Subsequently another gorilla approaches, and it is desired to find out what it will say in response to the utterances of the first. By comparing the two it is hoped to get an inkling of the meanings intended. So a blank cylinder will be set going on the machine to receive the words of the second gorilla, while at the same time the first cylinder is kept going round and repeating aloud the yelps and howls of gorilla No. 1.

For the purpose of demonstration after his return, the Professor proposes to take photographs of the gorillas, the cage, and himself, by an ingenious plan of his own. Instantaneous cameras will be arranged outside the cage so as to take pictures at any moment desired. It will add greatly to the interest of the results expected if he can show, when he gets back, photographic representations of himself in the act of interviewing gorillas. Nothing more striking can well be imagined, than such flash-light impressions at night of a cage set up in the midst of the tropical forest, illuminated by electricity, with an enthusiastic scientist inside, listening to the objurgatory remarks of an assemblage of giant African apes. Prof. Garner anticipates that there will be some danger to be met with, but he goes prepared. He wants particularly to secure a live gorilla to put in the little cage, in order that he might have an opportunity to study its small-talk. He will take with him not only rifles and revolvers, but blow-guns and air-guns, in order to kill without making a noise. Some devices of his own for deadly purposes are of a most surprising nature, and capable of slaying on the instant, or stifling into insensibility the most formidable and ferocious animals. As to the nature of these marvellous weapons he does not wish to have anything published at present. From the Gaboon, Prof. Garner will make his way across Africa, and thence around the world, studying the monkeys of all countries, and recording their language as he goes. His belief is that it will be possible to establish intelligent communication with monkeys, as soon as a little knowledge of their speech has been obtained. The expedition to the Gaboon region will start before April. The negroes of the Gaboon region believe that gorillas are accursed individuals of their own species. To them, these giant apes are dumb, hairy men, condemned for crimes committed in a previous state of existence to loss of speech and a wild life in the forest. Some tribes hold the opinion that these anthropoids are the embodied spirits of wild men of the interior; coast men similarly embodied, being represented by the milder and less dangerous chimpanzees. On account of this belief in a relationship, as well as through dread of the beasts, it is usually impossible to induce the natives to hunt the gorillas. As much as £1,200 has been offered for a live specimen unsuccessfully, because even so great a bribe could not persuade the negroes to attempt the capture. Their fear of the animals being partly based on superstition, gorilla skulls are regarded as powerful fetiches. In 1851 and 1852 these great apes were seen in large numbers on the coast of West Africa, below the equatorial line, and it was believed that they were driven from the interior by scarcity of food. The gorilla is probably the most formidable animal in existence. Imagine a man 6 feet 2 inches in height, and measuring 4 feet 6 inches across the shoulders. Give him a girth about the chest of 70 inches, and arms long enough to reach nearly to his ankles when he stands erect. Make him muscular in proportion, with huge canine tusks, and a jaw strong enough to crush a rifle-barrel. Suppose him to have no neck, an immense belly, very short bow legs, long black hair all over his body, a flat nose, and feet like hands. There you have a fair description of a gorilla of the largest size. Ordinarily these animals do not exceed 5 feet in height, with a breadth of 4 feet across the shoulders. Much as they resemble men when grown, they are much more human in appearance during the early stage of their being, having a likeness to babies in many ways that is most striking.

Gorillas live in family groups, each consisting of a male, one female, and her young. They do not frequent the same sleeping place often, usually spending the night wherever they happen to be. Choosing a full-grown tree to build a lodging in, they bend the branches together at a height of 20 feet or more, thus making a sort of bed which they cover with twigs torn off for the purpose or with leaf-moss. The male spends the night crouching at the foot of the tree, against which he places his back, in this way remaining on guard to protect the female and young in the nest above from attack by leopards. These powerful carnivora are always ready to devour any species of ape they can capture. In the day-time the gorilla family roams about the forest seeking food. In walking the animals totter along with a swinging gait, supporting themselves partly by resting the knuckles of their hands upon the ground. Much of their locomotion, however, is accomplished by climbing from tree to tree. They are very skilful climbers, and, if one branch does not seem sufficiently strong to bear their weight, they will use three or four at once. As soon as a young male reaches maturity, a conflict for the mastery ensues between itself and its father, which results in a final settlement of the question as to the ownership of the family, the weaker one being either killed or driven away. The male gorilla arrogates to himself the same right not to labour which is assumed by human savages. His business is fighting exclusively, and he

does not usually condescend even to gather food, his wife, and children collecting fruits and other delicacies for him to devour. If they are not sufficiently nimble in this employment, he shows his resentment by growling and boxing their ears. When he fights he stands erect upon his hind legs, the hair on his head and the nape of his neck bristling, his frightful teeth displayed and his forehead wrinkling with a fearful scowl. At the same time he beats his mighty chest resounding blows with his fists and utters most terrific yells of "Kh-ah, kh-ah!" which make the forest re-echo. He parries blows with the dexterity of a practiced boxer, and his method of attack is usually to seize his human adversary by the arm, crunching the limb in his teeth; or he throws the man down and rends him with his huge canines. The best thing that the hunter can do at close quarters is to permit the beast to seize the barrel of his gun, which it will at once carry to its mouth. Thus directed, a bullet is likely to be a settler. Otherwise, the gorilla will quickly crush the gun-barrel between his teeth, and proceed thereupon to wipe out his opponent. To run away is an impossibility in the thick woods.

There are several most interesting species of giant apes in the region which Prof. Garner proposes to visit. One of them is the bald-headed n'schiego, as the natives call it, which stands about 4 feet high when erect, and extends its arms 7 feet from finger-tip to finger-tip. It builds most remarkable nests in the trees, as high as 50 feet from the ground, choosing for its home the loneliest part of the forest. These shelters are made of leafy branches, which the female gathers while the male performs the process of construction. The branches are fastened together with vines, and the roof is so closely and carefully constructed as to resemble human handiwork. These animals live in pairs with their young like the gorillas, though sometimes a solitary bachelor n'schiego, covered with the silvery hair of age, will be found dwelling alone. They build a new nest every ten or fifteen days, the old one serving no longer as a protection against rain when the leaves which serve to thatch it have become dry. The Soko is another species of about equal size, which was made known first by the explorer Livingstone. It lives in communities of about a score each, half males and half females, not counting the young. Each male has its own wife, and all intruders from other colonies are driven away. In fighting with each other or with men who hunt them for food, the Soko always try to get hold of the hands of his adversary and bite the ends of the fingers off. The natives believe that the spirits of the dead rise as Sokos. Still another great ape is of an extraordinary frog-like shape, and is known as the Koola-kamba. It has a cry of "koola, koola," which it continually repeats.

The chimpanzees are found all the way across Africa in the same latitude. They make nests in the same way that gorillas do, the male squatting on guard at the foot of the tree at night. In the morning and evening they make the forests resound with their horrible wails and screams. Although they will run away from man, they are very dangerous adversaries when brought to bay. They are the most intelligent of all the apes, and, indeed, approach most nearly to the human of all the lower animals. Buffon had a chimpanzee in 1740, which sat down to table like a man, opened its napkin and wiped its lips, used a spoon and fork, poured out wine and clinked glasses, poured tea and put sugar in it, washed windows, and tried to imitate his master in writing with a pen.

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PHRENOLOGY EXPLAINED.

By Stackpool E. O'Dell,
Author of "Phrenology: its Truthfulness and Usefulness," "Old St Margaret's," "Merciful or Merciless?" "Brompton Lectures," "Mental Troubles," etc.
[RIGHTS RESERVED.]

XII.

In our explanations of phrenology we have heretofore spoken of individual organs of the head as mapped out by phrenology, and we would now conclude this series by pointing out the groups of organs. The perceptive group we have already pointed out. It is denoted by size over the eyes, and enables people to learn from observation. The reflective group gives width and protuberance to that portion of the head that we all understand as the forehead. When large in this region we expect to find ability to reason, to reflect, cogitate, and philosophise. The moral group is manifestly large when the head is high from the opening of the ears and full on the top. This should be the governing group. No matter how large the other groups are, if this one preponderates, we shall have actions of an upright and honest nature. At the side of the head, immediately behind the forehead, giving width across in this region, we have some of the most refining and elevating organs. When large we expect an appreciation of the beautiful, from the ideal to the sublime, in either nature, art, or imagination. A little lower down and more to the back, giving width between and in front of the ears, we have the selfish and preservative organs. When properly controlled, size here is to the advantage of the individual, giving energy, determination, and force of character, ability to overcome obstacles, and to be aggressive and destroy for good purposes. Right at the back of the head we have the domestic group, which, when large, will manifest a love for home and affection for family ties. This gives a brief outline, by no means perfect, of the indications that various portions of the head denote concerning expected mental manifestation. No organ or group of organs can be calculated upon separately with any good result. The phrenologist has to take the whole head into consideration, each organ individually, first, and then in combination with all the others. One deficiency may upset the balance of an otherwise well-formed head. Even here the phrenologist does not stop, for, in order to be accurate, he must take into consideration the temperaments of the individual, because they give an indication of brain vitality. The temperaments that are now generally accepted are denominated mental, motive, and vital. Where one of these three is of a very pronounced nature, it becomes a very strong factor in mental manifestation. The general health should likewise be a matter of great consideration with the phrenologist before deciding about the mental power of an individual. In some directions the power of phrenology is much more limited than what people imagine. For instance, it cannot tell what any man has done, or what any man will do. It points out the bent of the faculties or the inclinations of the individual. It shows with a good degree of certainty what reliance a man can place in his faculties, for the accomplishing of various transactions. It shows him those faculties that would be likely to lead him astray through their excess or inadequate strength. Phrenology is competent to give most useful information in regard to all classes of education, the treatment of the insane and criminals. Phrenology can be found very useful to statesmen in the government of a country by pointing out the mental constitution of man, so that such laws will be made that will harmonise with it. In

individual, social, and national life, phrenology can be a true philosopher and guide, for it is the science of the mind. It is a science in itself, not a theoretical or speculative, nor even an experimental, but a practical science, and although the more a phrenologist knows concerning all other subjects the better he can apply phrenology, yet it is not a dual science, nor a combination of other sciences. While anatomy, vivisection, and pathology have here and there confirmed the science of phrenology, they have not added to it; they have made no discoveries—at least, since Dr. Gall's discovery of the connection between mind and brain—except, indeed, the statements of Darwin, Huxley, Tyndall, Herbert Spencer, and Ferrier, be accepted as a scientific fact, that the mind is an emanation from the brain; but this statement has been so extensively rejected that we need not set it down as a discovery. What other scientists accept is in harmony with phrenology, that the brain is the organ of the mind, thereby acknowledging the existence of both a mind and a brain.

THE SHAPE OF BACTERIA.

The latest investigations show that bacteria are spheroidal, rod-like, or spiral. Under the most powerful microscopes they are found to have a granular mass in the centre, surrounded by a thin, structureless membrane. Under favourable conditions, with plenty of food, they divide across the middle, each part growing longer and again sub-dividing, and so on indefinitely. If this should go on for a few weeks, these minute animals would become so numerous that they would use up all the carbon, hydrogen, oxygen, and nitrogen there is available for life purposes. But their increase is limited by the facts that the food supply gives out, the sun is their deadly enemy, and many other causes.

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SCIENCE NEWS AND NOTES.

"Life is a quarry, out of which we are to mould and chisel a complete character."—GOETHE.

Antipyrin

may be considered one of the drugs of fashion. Every lady likes to doctor her dear friends—male and female. A few grains of antipyrin are so easily prescribed, and hence the drug became a fashionable craze. Since its powers for good or evil are not even understood by its discoverers, we have not far to seek for a reason why antipyrin is extremely dangerous in the hands of amateur self-medicationists. We advise ladies to abandon this easily-administered drug, unless taken under advice, as also salicin, exalgin, phenacitin, and other such substances. We look forward to the day when the legislature will step in and forbid the sale of such drugs without a medical prescription. In France the sale is already severely restricted, and in Germany the law we advocate above has been in force since the first day of this year.

The Theory of Life,

as discussed in our last and present issue by Mr. Edison, is not without the warrant of philosophy. The great German philosopher Loetze, for instance, holds that all atoms are conscious and of a spiritual nature. In this way he undertakes to account for the soul. What we call soul is, according to his theory, only a dominant atom. This view is reconcilable with the laws of evolution on the hypothesis that the strongest atoms survive, or more correctly, perhaps, that they control the weaker atoms. The difficulty, of course, arises when we begin to select words with which to express so abstract an idea as life. Whatever form of expression is adopted, it is not likely to mean the same thing to all men. An atom, we understand, occupies some space. But is not the first principle immeasurably illimitable? But anything that occupies space cannot be the first principle. Loetze, holding that the so-called facts of life can be explained by mechanical forces, eliminates the term life or vital force and believes only in soul. Loetze must believe that the soul can come into mechanical relations. This consciousness of atoms he extends resolutely to all material objects, even to crystals. However, the atoms, he contends, have no distinct existence, but are all purely dependent upon the soul, which is God.

All the Analogies of Physiology

are quite consistent with Mr. Edison's views. The time it takes to send a message from the brain to the muscle which is to work has been measured. Therefore, we own we have some definite nerve force with which to draw. What that nerve force is we do not know. We know what it is not. It is not chemical; it is not magnetic. There is much that is very suggestive with regard to Mr. Edison's proposition that all matter is conscious. Man we know is not a simple organism. He indulges in what physiologists call "conscious and subconscious cerebration." We are pleased to call this subconscious cerebration automatic. But although our higher consciousness is unaware of what our lower consciousness is doing, this does not alter the fact that the latter may be just as conscious as the former, although a wall keeps the two centres of volition from exchanging confidences. If, then, we admit this much, the hypothesis that each individual protoplasm and each individual atom contributing that protoplasm is conscious is certainly quite reasonable, although from the point of view of physiology there is no life properly so called without protoplasm.

Edison's Hypothesis

has nothing to fear from the physicist. Crystals certainly live. When it is considered that it is demonstrated that these stone plants are affected by light, it can be realised that they are not so insensible as popularly supposed. The life of crystals is a different kind of life than that of plants, but they live in their own way quite as decidedly as do plants and animals.

Theories about the Ether

are so plentiful that we almost wonder no scientist has wandered from the pleasant path of hypothesis into the difficult realm of practical experiment and demonstrated what it really is. Nothing in a painstaking way has actually been done in this direction. No one will quarrel with Mr. Edison for his views on the subject; he has to much common

sense to accept unproven theories, especially when they are difficult of assimilation, and he therefore prefers to wait developments. In dealing with the theory and function of ether, we must not forget, however, certain facts that would tend to prove what the theorists advance.

The Slowing-up of Light

in space occupied by matter shows that the ether within must be either more dense (as Fresnel believed) or less elastic than that existing in free space. It is certainly very difficult to understand what there can be in the molecules of matter that can increase the density of an incompressible medium. Experiments show apparently that the ether at the surface of the earth moves with it. It is dragged along as if it were a viscid liquid. The field of a steel magnet is, however, a rotational phenomenon. It is a spin which is maintained permanently without the expenditure of energy. It seems, therefore, that the resistance to shear which shows itself in the adhesion of the ether to the moving earth must be a rigidity due in some way to motion. Other experiments on the motion of light in moving columns of water have been taken as proof that the ether in the water is condensed to nine-sixteenths of its volume in air. The ether in water certainly behaves as if it were more dense, but it is another matter to say that it is so. It seems improbable. One question to be settled is whether the ether or any part of it is at rest in space, or does it sweep through the interior of bodies that move through it as wind sweeps through the leaves and branches of a tree?

Vegetarianism

can never be said to have seriously engaged the attention of a large portion of the community. Some years ago it became a fad in a certain class, but the fad died as quickly as it was born. We remember attending by invitation a vegetarian banquet at the Health Exhibition. This was our only practical experiment in testing the benefits claimed for vegetarianism. The experiment was, however, so painful that we did not repeat it. We declined to be converted. One gentleman who lived for a long time as a vegetarian without feeling any better or worse than formerly with mixed food, made one day the disagreeable discovery that his arteries began to show sign of atheromatous degeneration. Particularly in the temporal and radial arteries this morbid process was unmistakable. Being still under forty, he could not interpret this symptom as a manifestation of old age, and being, furthermore, not addicted to drink, he was utterly unable to explain the matter. He was a medical man, and, therefore, turned it over and over in his mind without finding a solution of the enigma. He, however, found the explanation quite accidentally in a work of that excellent physician, Dr. E. Monin, of Paris. The following is the verbal translation of the passage in question :—"In order to continue the criticism of vegetarianism we must not ignore the work of the late lamented Gubler on the influence of a vegetable diet on the chalky degeneration of the arteries. Vegetable food, richer in mineral salts than that of animal origin, introduces more mineral salts into the blood. Raymond has observed numerous cases of atheroma in a monastery of vegetarian friars, among others that of the prior, a man scarcely thirty-two years old, whose arteries were already considerably indurated. The naval surgeon, Treille, has seen numerous cases of atheromatous degeneration in Bombay and Calcutta, where many people live exclusively on rice. A vegetable diet, therefore, ruins the blood vessels and makes prematurely old, if it is true that man is as old as his arteries. It must produce at the same time tartar, the senile arch of the cornea, and phosphaturia." Here, then, is the whole mystery solved why pure vegetarianism is inferior to a mixed diet, except as a curative method which is invaluable in various morbid states. It must not be forgotten, however, that over-eating is as certain to cause arterial sclerosis (hardening) as any special diet.

Mussel Poisoning

has had some light thrown upon it lately by the observations of Dr. Andrew Wilson. He quotes some opinions which are specially interesting, because they have reference to the phases of the moon as influencing mussel-life. It seems that the natives of Tierra del Fuego are in the habit of eating large quantities of mussels as part and parcel of their ordinary fare. A certain Argentine medical man tells us that the mussels are not injurious at their maximum period of growth (whatever that may mean), which corresponds, *mirabile dictu*, with the time of full moon. When the moon wanes, it is added, the mussels fall off in condition and become poisonous. It is further remarked that the poisonous properties of the mussels result from molluscs. The decomposing bodies of such as have succumbed liberate certain poisonous principles, known scientifically as *ptomaines*, which are absorbed by the living molluscs to the detriment of those who consume them; so that mussel poisoning in Tierra del Fuego seems to be a condition they have always with them.

Fatalities

resulting from mussel poisoning are only too familiar to everyone, but the scientific mind cannot altogether credit this report. There occurred a literal epidemic of this nature at Leith somewhere about 1840, when it was shown that mussels which had been taken from the docks, or from ships in the docks, caused symptoms of poisoning, with a number of fatal cases; so that it cannot be denied that mussels may, under certain conditions, be dangerous as articles of food. But, unless mussel-life at Tierra del Fuego is decidedly more directly under lunar influence than mussel-life here, it is difficult to agree with the opinions of the Argentine medical man quoted. Dr. Wilson tells us he knows of no facts in molluscan history which teach that mussels develop and decline with the moon. This is teaching contrary to the biological facts about mussel-life at large, and he suspects the details in question have become swathed in some popular conception or other regarding lunar influence, similar to that which credits food exposed to the moon's rays with developing injurious qualities. It is more feasible to suppose that if, from any cause, mussels die, they may give rise to putrefactive products capable of causing illness; though again it is a moot point whether a living mussel can absorb such products and transmit them unchanged to its devourer. The item of news so ably criticised by Dr. Wilson seems to afford an excellent example of the care with which reports should be scrutinised. People are apt to take for granted that such statements, made authoritatively, must needs be correct. This is often very far from the case, and a little reflection, backed, of course, by scientific knowledge, often suffices to dispel what would be otherwise a very alarming piece of news. When mussels, or any other description of shell fish, cause injurious symptoms, they are usually eaten in a raw state. Thorough cooking, in this respect, as in so many other dietetic phases, is the safety of the consumer.

The Chemical Composition of the Lettuce

has thrown the English medical press into a perfect ferment. Most readers know that the familiar item in our salads con-

tains a certain substance known as *lactucarium*, or lettuce-opium, which derives its popular name from its presumed soporific or narcotic properties. Dr. Andrew Wilson is very sceptical about these properties; for, if the lettuce was capable of inducing sleep, even in a mild degree, salad-eaters should be lulled into somnolence with an ease and celerity which would certainly be both noticeable and inconvenient. The juice of the lettuce, even when chemically separated and treated, has lost credit as a medicinal substance, and it is no longer used in pharmacy. But there comes to hand about the lettuce an item which is scientifically interesting, even if it is economically and socially unimportant. We are now told that chemists have discovered not only in lettuce, but also in cabbage, minute amounts of the active principle of belladonna and henbane, "hyoscyamine" by name. If, therefore, the lettuce be regarded as possessing any sedative properties whatever, it would seem that we should attribute these qualities not to the lettuce-opium *per se*, but to the hyoscyamine. A medical journal goes the length of stating that fatal results have followed the taking of large quantities of lettuce. Dr. Wilson doubts this statement. There are people known who certainly, on occasion, consume immoderate quantities of lettuce, and this without experiencing any untoward effects whatever. The next thing we shall be warned against will be the harmless lettuce, and it is well to prepare ourselves for the solemn, Cassandra-like attitude the medical prints are certain to assume. None the less, we may fearlessly enjoy the healthful salad. Is this warning "another injustice" to the vegetarians? Doubtless we shall hear of their vials of wrath being poured out upon the scientific alarmists.

A Prize of £1,000

(25,000 francs) has been offered by the King of the Belgians for the work giving the most satisfactory replies to the following questions:—Describe, from the sanitary point of view, the meteorological, hydrological, and geological conditions of the territories of Equatorial Africa. Deduce from the present state of our knowledge concerning these matters the hygienic principles suitable for these regions, and lay down, with observations in support of the conclusions arrived at, the best scheme of life, diet, and work, as well as the system of clothing and form of dwelling best adapted for the preservation of health and vigour. Describe the symptomatology, etiology, and pathology of the diseases which characterise the regions of Equatorial Africa, and indicate the treatment, both prophylactic and therapeutic. Define the principles to be followed in the choice and use of medicaments and in the establishment of hospitals and sanatoria. In their scientific researches, as well as in their practical conclusions, competitors should particularly take into account the conditions of existence of Europeans in the different parts of the Congo basin. The prize is open to foreigners as well as to Belgian subjects. Competitors must send in their works to the Minister of the Interior and of Public Instruction at Brussels before January 1st, 1897.

Wood-lined Walls

were advocated in a recent issue of SCIENCE SIFTINGS as being more hygienic than any other method of construction. A correspondent thinks we must have made a mistake in this, "for wood linings to the walls of houses have long been condemned by sanitarians, Mr. H. H. Statham strongly condemning them in his paper, read before the Congress of Hygiene and Demography." This was not the only fallacy imposed on the public through the medium of the Congress of Hygiene and Demography. Everything that was uttered there was accepted as gospel truth, and no actual criticism by competent authorities was attempted. As a matter of fact, wood panelling, if treated in a thoroughly antiseptic manner and covered with impervious varnish, is a most wholesome lining for a house; but we also agree with our correspondent, that walls set in trowelled stucco and painted, are impervious, durable, and in the end cheaper than either wood-lined or papered walls.

Artifical Colouring of Birds

has formed the subject of some interesting experiments by Dr. Sauermann, the distinguished naturalist. It is a recognised fact that canaries that receive with their food quantities of cayenne pepper gradually change the colour of their plumage from yellow to red. Cayenne pepper contains besides a pigmenting matter, an irritant and a greasy substance. When these two latter are extracted by a maceration in alcohol, the pepper loses its colouring effects. But if olive oil, the result of the maceration, be added, the colouring action re-appears. It is obvious, therefore, that it is the fatty portion of the cayenne pepper which forms the necessary vehicle of the colouring process. Experiments made upon white fowls have yielded identical results. The fowls experimented upon possessed the remarkable property of foretelling a change of temperature by a pronounced change in the colour of the new plumage.

A Method of Making Bread from Wood

has been discovered by Dr. Krug, a German physician. This new system of bread making consists in converting the cellulose into grape sugar, which is easily assimilated by the animal organism. Basing the experiment upon the properties of glucose obtained by the conversion of the cellulose, Dr. Krug makes his bread or biscuit by adding to the glucose about 40 per cent. of wheat, rye, or oats. This biscuit has undeniable nourishing qualities, to which the inventor has still further added by using with the dough, phosphates, and all elements for bone formation. This wood glucose bread, as it may be termed, is, moreover, excellent for the rearing and fattening of cattle, and should prove an effective and more economical substitute for the oil cakes usually given to cattle, for its nutritive and bone-forming qualities are vastly superior in every respect.

The Production of Lead

has grown much in recent years. The world's output at the present time is estimated at 500,000 tons per annum, and a new mine of great richness has lately been discovered in North America. An interesting fact is the change of localities for the manufacture of lead, of which the United States have been the first to profit. When the United States Government discovered that its own production was nearly sufficient for itself, it levied such heavy duties as to place a great restriction on the import of the metal. The production of the metal in the United States has developed itself to an amazing degree. From 8,000 tons in 1830, it grew to 17,830 tons in 1870, and to 97,825 tons; now the minimum annual output is no less than 170,000 tons per annum. In Europe the production has arrived at its zenith. Germany comes first with about 100,000 tons, then Spain, Great Britain, Italy, Austro-Hungary, Belgium, etc. During the past thirty years the production of Germany has been as follows:—1861 to 1865, 37,200 tons; 1881, 91,200 tons; 1889, 104,525 tons; 1891, 101,781 tons. All this tends to show that it is to America the world, in years to come, will have to look for its lead supplies.

Natural Musk

is sold retail at the extraordinarily high price of sixpence per grain. An artificial substitute has, however, recently been discovered which can be sold at a greatly reduced rate. This substance is the product of the action of nitric and sulphuric acids upon the hydrocarbon meta-butyl-toluene ; it crystallises in yellowish white needles, but natural musk is black.

A Buckler of Aluminium and Copper

has been reported upon favourably by a committee of the French War Office. It is believed that a shield could be made out of this combination light enough to be carried without serious difficulty, and strong enough to stop even the modern rifle bullet, except at very close quarters. From a shield to a coat of mail would be but a short step, but it is not likely to be taken just yet. However light the new shield or armour might be, it would either increase the soldier's burden or necessitate the omission of some other part of his equipment, already reduced to the narrowest limits compatible with sustenance and a proper supply of ammunition. Extra weight would result in slower marching—an alternative not to be thought of in these days of rapid evolutions.

Asbestos

differs from nearly all other minerals in being fibrous and textile, dividing into fibres resembling in delicacy those of flax and silk, and can be spun and woven like any other textile fibre giving a yarn or cloth entirely fire proof and acid proof. Although known in Egypt and elsewhere three thousand years ago, the practical use of this material in considerable quantities has been delayed to the present age. The finer kinds of asbestos, which are pure white and silky with strong fibres, are comparatively rare and expensive (the same being free from silicic acid and metal oxides) and in consequence of their lubricating qualities are particularly valuable for technical purposes. These kinds of asbestos have only been found in Canada and some parts of the United States. The asbestos found in Italy, Switzerland and Germany is coloured, grey and yellow, and more compact. These qualities are much cheaper than the American; but being far inferior, their use has largely ceased.

Since the Discovery

of the American asbestos the use of the kinds previously found in Italy has largely fallen off. Asbestos mining in the remainder of Europe has, so far, amounted to little. The principal qualities of the American asbestos chiefly consist in being absolutely indestructible even when exposed to the action of any known acid and its possessing at the same time in the highest degree that peculiarity of a self-lubricator, viz., a soft, greasy or soapy feeling, which has brought plumbago, soapstone and chalk into favourable notice. The use of asbestos in connection with india-rubber is now practised in various directions. Asbestos and india-rubber woven sheeting, for instance, consists of asbestos woven cloth, coated on both sides with india-rubber and then vulcanised. It is used as a substitute for the asbestos millboard for packing for steam joints and in other situations where it is desired to resist both heat and moisture, while affording a high degree of elasticity. Asbestos and india-rubber woven washers are also made, and asbestos and india-rubber woven tape, for making steam and water joints. Asbestos rolled cloth packing is made both with and without india-rubber core. Asbestos block packing consists of an india-rubber back, upon which there are built up edgewise a number of layers of asbestos cloth. Sufficient elasticity is thus imparted by the rubber back, while great durability and protection to the rubber is insured by the use of asbestos.

Ploughing with Dynamite

is one of the latest and most innocent uses to which this infernal explosive has been put. The dynamite is fired electrically and succeeds in loosening the earth to a depth of two or three feet, and thus allows the absorption of considerable moisture in periods of drought. The inventor of this ingenious tilling of the soil drills holes two or three feet deep and five feet apart, making 1,600 to the acre. In each hole is placed a sufficient quantity of the explosive, connected with a wire leading to the battery, and after the holes have been plugged with clay, the whole is discharged by a spark. In recent experiments made, each charge was about one-fourth the size of a small-sized dynamite cartridge, containing about one ounce of powder. After the explosion the ground appeared to be lifted two feet, some clods being thrown to the height of thirty feet, while the earth was found to be broken to the depth of thirty inches at the point of explosion and for a considerable distance around the holes.

Glue in Surgery

has been employed for the first time in some of the surgical clinics in Germany. It is used for holding dressings in place in all those cases where elastic collodion and solutions of rubber are found so convenient, especially in holding dressings over fractures, while at the same time permitting free motion of the parts. It has the advantage of not cracking or breaking, of holding firmly, of being very pliable, allowing a great amount of motion, and, lastly, of not preventing the exercise of the function of the skin over which it is placed, so that there does not occur any peeling off of the upper layers of epithelium with a tendency to eczema. This glue is composed of glycerine, gelatine, and water, of each 30 parts, and 10 parts of oxide of zinc, this making what is known as the thick paste; the thin paste has 30 parts glycerine, 20 parts gelatine, 40 parts water, and 10 parts zinc oxide ; the mixing of these elements is, of course, done over heat, and the paste is liquified over a water bath when needed. When ready to apply, the part is well dried with a brush, a ring made round the part to be inclosed, and the gauze of the dressing then laid on, care being taken to have the pieces cut large enough to allow the edges to extend into the ring of paste already laid on. Over this is placed a single or double layer of gauze, cut somewhat larger ; the whole is now painted over with paste, and the dressing is finally daubed over with a bunch of cotton held in the hand.

The Terrible Power of a Modern Gun

is a thing to marvel at, and unless one is actually brought into business relations with the great science of modern warfare, it is difficult to conceive of the awful potency of the latest and largest guns. These engines of destruction, weighing 110 tons, hurl a projectile of solid steel 16 inches in diameter and nearly 4 feet long at a velocity of 2,079 feet a second. When tested recently, one of these guns sent a shot through 20 inches of steel armour, 8 inches of iron, 20 feet of oak, 5 feet of granite, 11 feet of concrete, and 3 feet of buck. Comparatively, a locomotive weighing 200,000 pounds would have to spin along the tracks at a rate of 135 miles an hour to strike a blow equal to that projectile. Think of the damage wrought in a railroad collision where a train speeds along at a rate of 30 miles an hour, and one may calculate the destructiveness of modern ordnance.

SCIENCE QUERIES AND ANSWERS.

A prize of two shillings and sixpence will be awarded for every interesting question asked by our readers and published in this column and five shillings will be given for every answer published. In all cases when the same question or reply is sent in by two or more correspondents, the award will be given to the one whose letter is first opened. Questions asked by correspondents and not replied to by our readers, may, if of sufficient interest, be dealt with Editorially.

Rules for Competitors.—(1) Only one question may be sent each week, but any number may be answered. (2) Write on one side of the paper only. (3) Envelopes must be marked "Science Queries and Answers," and must arrive not later than the Monday following date of publication.

These Prizes are intended to take the place of the "Prize Science Sifting," which will accordingly be discontinued.

QUERIES.

1.—How fast do waves travel; and what is their greatest height in mid-ocean? I have been told they never exceed 32 feet—the height to which water may be drawn up by a pump.

2.—When was the sun-dial invented?

3.—What is the rate at which letters are conveyed by pneumatic tubes? What course is adopted in case one of the letter-carriers should stick in the tube at some unknown point?

4.—Are any flying fishes to be found on our coasts?

5.—Of what capacity is the largest pumping engine now in use?

6.—What is the scientific explanation of the "tears of strong wine?"

THE PRIZE SCIENCE SIFTING.

We have awarded the prize of One Guinea to Mr. H. FRENCH, 15, Broadway, Wimbledon, S.E., for the leading "Science Sifting." The other siftings published all deserve honourable mention.

Ants.

The most prevalent and inexcusable error respecting ants has been the belief that they hoard up grains of corn, chiefly wheat, for their supply during the winter, having first bitten out the germ to prevent it from growing in their nests. This notion, however, is now completely exploded with regard to European ants. The mistake has no doubt arisen from the great similarity both in shape, size, and colour of the pupa or chrysalis of the ant to a grain of corn, and from the ants having been observed to carry them about and to open the article to let out the inclosed insect. It is now ascertained beyond a doubt that no European ants hitherto properly examined, feed on corn or any other kind of grain, nor has any species of grain been yet found of any kind laid up in its nest. The truth is, that ants are chiefly carnivorous, preying indiscriminately on all the soft parts of other insects, and especially the viscera; also upon worms whether dead or alive, and small birds or animals.

To Magnetise is to Impart Polarity.

If iron filings be sealed in a glass tube and magnetised, it will be seen that the filings turn so as to lie longitudinally along the tube. The whole is then a magnet, but only so long as the tube remains unshaken. This surely suggests that to magnetise a substance is to impart polarity to its particles, in fact that every particle is naturally a magnet though the aggregate result of the want of arrangement is that the tiny magnets neutralise each other. This theory derives support from the greater difficulty experienced in magnetising hard than soft iron, and the greater permanence of the magnetism when imparted. Altering the natural arrangement of particles would, undoubtedly, produce stress, or strain, and when the magnetising influence is removed, the particles being free to move, return to their original arrangement. This re-arrangement may even be rendered audible. If an electric current be passed round a knitting needle so as to temporarily magnetise it, there may be heard a distinct click at the moment of ma ing and breaking contact, presumably due to molecular movement. That there may be no mistake respecting the cause of the sound, the key may be depressed at a distance.

Arthur Woodward, 12, Achilles-road, N.W.

All-Prevailing Alcohol.

Recent research has shown that alcohol is present in Nature to an extent few imagine. An eminent French chemist, M. Munty, has, he asserts, been able to detect its presence, although in infinitesimal quantities in water. Several growing plants contain it, notably the parsnip, and the earth also contains alcohol, especially when rich in organic matter. M. Munty maintains that there is every reason to believe that it exists in the air, and explains its diffusion in Nature by the destruction of organic matter by various agents of fermentation. This theory amounts to breathing alcohol, drinking it in water, and being buried in alcoholic earth—sad tidings for abstainers all.

Wm. M. Saunders, 3, Park-place, Leith.

Dragons.

Our forefathers were not so very wrong in their belief in dragons—winged monsters, scaly and terrible. Geology proves the existence, millions of years ago, of immense reptiles, with snouted jaws, armed with sharp teeth, and possessing bat-like wings attached to one of the enormously elongated "fingers" of the forepaw or hand, the other fingers being furnished with large claws. Some bones found in the Cambridge Greensand furnish proof of a flying reptile, the expanse of whose wings was twenty feet. The ancient Liassic seas swarmed with sea dragons, wingless fish-lizards, twenty and thirty feet long, some with short necks and large heads, others with long necks and small heads. These reptiles were very voracious, as is proved by the bones of the latter having been found encircled by those of the former, both creatures being of a similar size. It is easy to imagine the astonishment of primitive man at first beholding the remains of these creatures washed out of a cliff by the sea, perchance—as fossils often are—and the subsequent building up of legends around the same, culminating at last in the mediæval "dragon."

A. G. Hammond, 10, St. John's-hill, S.W.

The Queen Bee.

Concerning the queen bee, we have some interesting information given us by W. H. Harris, B.A., B.Sc. He says, "All her wants are supplied by her subjects. She mates once a year, with a single drone, and on the wing. That is the only occasion of her leaving the hive except when she leads forth a swarm. Her grand function is to lay eggs, and every part of her structure is related more or less to this all-important duty. She is free from every other office. The hatching, the tending, the rearing, the instruction of her progeny, are entirely taken out of her hands, and it is doubtful whether she has any affection for her children. She is constantly attended by ten or twelve "maids of honour," who all keep their heads turned towards her, clear the way for her, prevent all crowding round her and supply her with the most nutritious food, previously half-digested by themselves. They caress her with their antennæ and seem to find a real joy in mere proximity to her person."

Lottie M. Clarke, Layer Wick, Colchester.

GLEANINGS OF THE GLOBE.

ONLY one person in a thousand dies of old age.

AN inch of rain means 100 tons of water on every acre.

THERE are at least ten million nerve fibres in the human body.

ONE half the people that are born die before the age of sixteen.

THREE and a half millions of people are always on the seas of the world.

THE force required to open an oyster appears to be 1,319½ times the weight of the shell-less creature.

IT has been calculated that there are about 200,000 families living in London on about £1 a week.

THE proportion of Anglo-Saxon words in the English Bible is 97 per cent. of the whole.

THE receipts of the French Treasury are larger than those of any other civilised nation.

AS many as fourteen hundred eyes have been counted in the head of a drone bee.

COLD is simply the absence of heat. There is no element to which the effects of cold can be attributed.

ONE hundred ounces of oil burnt in the atmosphere produce 130 ounces of water.

THE seeds of some plants of fruits will not germinate until they have passed through the digestive organs of an animal.

THE thickness of the human hair varies from the two-hundred-and-fiftieth to the six-hundredth part of an inch. Blond hair is the finest and red the coarsest.

THE smallest known insect, the Pteratomus Putnamii, a parasite of the ichneumon, is but one-ninetieth of an inch in length.

A RECENT survey has established the number of glaciers in the Alps at 1,155, of which 249 have a length of more than four and three-quarter miles.

A GRAIN of carmine or half a grain of aniline will tinge a hogshead of water so that a strong microscope will detect colouring matter in every drop.

A LUMINOUS buoy has been invented, the light of which is produced by phosphuret of calcium, and is visible two and a half miles away.

IT takes about three seconds for a message to go from one end of the Atlantic cable to the other. This is about seven hundred miles a second.

ABOUT 450 B.C. the Ionians first introduced the present system of writing from left to right; previously to the above date from right to left prevailed.

A MATHEMATICIAN has discovered that a bicyclist can travel fifteen miles over a good road on his wheel with less exertion than he can walk three miles.

THE ruddiness of the rising moon is due to the absorption of the more refrangible rays of light by the great distance that the moon's rays pass through the atmosphere at rising or setting, aided by the hygrometric condition of the air, the water in the atmosphere probably being the most active agent of absorption. The midday sun looks red as seen from a considerable depth in water. Divers notice this peculiarity.

BY the subjection of common air to a pressure of 1,125 pounds to the square inch, or 75 atmospheres, with a condenser kept at —135° C., the air is reduced to liquid form; and the liquid, when allowed to evaporate, produces a temperature of —200° C. This is within 73° of absolute zero, which is —273° C.

M. RENARD, the distinguished French aeronaut, is building a new dirigible air ship of over 3,000 cubic yards capacity. It is said that the motor is made of aluminium and operates perfectly. The balloon will soon be finished and will be tested shortly. It will leave Meudon and manœuvre between Versailles and Paris.

A LONG study of the parallax of Arcturus has led Dr. Elkin, of Yale University, to conclude that this star travels with the inconceivable velocity of 381 miles a second, or 21 times faster than the earth moves in its orbit round the sun. Arcturus proves to be so distant that its light, travelling 190,000 miles a second, must take 181 years to reach us.

"SILVER bronze" has a tensile strength of 57,000 pounds per square inch and 20 per cent. elongation. It can be rolled into thin plate, and has been drawn into small wire. It has an electric resistance considerably higher than that of German silver, and it is anticipated that it may afford better and cheaper wire for rheostats than any other known alloy.

BACTERIA of various kinds have been found in ice and snow, and Dr. Fontin, a Russian observer, has now proved that hailstones are not free from them. He has found that the water produced by the melting of hailstones contains, on an average, seven hundred and twenty-nine bacteria per cubic centimetre. As the ordinary dwelling-place of the bacillus mycoids is the earth, we are confronted with the fact that microbes of terrestrial origin may be carried up into the air, and thus rain, snow and hail may be the direct means of conveying infection.

AT a distance of from 500 to 600 paces a bullet from the new Austrian Mannlicher magazine rifle will go through a brick wall—so, at least, Professor Billroth has told his students at Vienna. It thus becomes well-nigh impossible to obtain shelter from an enemy's fire, and there can be no more marching in dense lines, as the ball goes through three or four men standing behind each other. "Thank God," said the professor, who had been exhibiting a collection of bones from persons wounded in the wars of 1866 and 1870, "I cannot show you any bones that have suffered from weapons as they are now."

A PRIZE OF £4,000.

Striking discoveries in astronomy, of a character to excite the public mind, have been rare in recent years. Those who have kept in touch with the work that has been done in that science are not ready to believe that this is because progress has not been made in it. As evidence of the new work accomplished by its students, and potentially fruitful work, too, we cite the preparation of a map of the sky, to be accomplished by the aid of photography, which gives the exact position of the stars to the fourteenth magnitude. The co-operation of observatories certainly assures the success of this immense work, which is now in process of execution. *La Nature* has made known the beginnings and has kept its readers in the current of the very minute and profound preliminary studies, without which the undertaking of operations of an extreme delicacy might have been compromised. It has also made clear the importance of the results to be obtained, and of the various consequences that would necessarily accrue from them. The problems of parallax or of stellar distances, of the proper motions of the stars, of nebulæ, the search for minor planets and new comets, everything relative to the constitution of sidereal systems, may, by an attentive study of the plates of the new celestial maps, receive positive solutions. A new horizon is thus opened to science. These are not sensational novelties, like the appearance of a comet with long, nebulous tail, which attracts the attention of idlers to the sky ; but the importance of astronomical observations is not measured by the noise they make in the public ear. Yet, if the prize of a hundred thousand francs (£4,000), which a lady has recently bequeathed to the French Academy of Sciences, should be gained by some one, the resultant emotion would be legitimate. To establish voluntary and direct communication between the earth and a planet, or rather between its inhabitants and the inhabitants of a planet, would be something to sharpen the curiosity of the whole world. We do not see that astronomy or mankind would gain anything by it, but what conjectures, what paradoxes, what high fancies, we should enjoy if it were carried out !

The Academy is said to be disposed to accept the legacy, by virtue of a clause like that which makes the Bréant prize an annual recompense allotted to the authors of discoveries tending to advance the solution of the problem of a cure for cholera. In the same way, the income of the capital bequeathed by Madame Guzman will work in favour of investigations relating to the constitution of the heavenly bodies. We do not think we are hazarding much when we assert that it will be a long while before the new prize is awarded, in its totality at least. But this was doubtless not the opinion of the testatrix. Without going deeply into the question—for that would require a long discussion—the probable correctness of our prediction can be shown in a few lines.

To any one well acquainted with the present knowledge possessed by astronomers concerning the physical aspect of the stars of our system, it is evident that only two of the planets are in a condition to encourage the hopes of those who believe in the possibility of interplanetary communications, to wit, the moon and Mars—the moon especially. Its small distance of 240,000 miles, the clearness of its disc, the facility with which minor features can be distinguished upon it with the telescope, the absence of all cloudiness that conceal spots upon it, make our satellite an eminently fitting body to which to send signals from the earth. We must believe that the inhabitants of the moon have not thought of this, or the numerous observers of its disc, the industrious authors of the lunar maps, the Beers, Mädlers, Schmidts, at least, would have perceived the signals. But stop. Are there, can there be, inhabitants in the moon, where air and water are absent ? If there is any point generally admitted, it is the negative of this question.

Under these conditions, it seems idle for us of the earth to trouble ourselves about means of answering the inhabitants of the moon, or of ourselves provoking signals thence; and this is a pity, for the second heavenly body to be questioned, the planet Mars, is infinitely less favourable for the establishment of an interastral telegraphy. At its most favourable oppositions, Mars is still 42,000,000 miles from us, or a hundred and sixty times farther than the moon ; while the diameter of its disc is only 25″. According to Schiaparelli, the smallest objects visible on its surface under the most favourable circumstances—such as a bright spot on a dark ground, or a dark spot on a bright ground—must have a diameter equal to a fiftieth part of that of the planet, or about eighty-five miles. This minimum can, it is true, be reduced by using large objectives permitting stronger magnifying ; but even then it is certain that luminous signals, for example, visible from the earth on Mars, must have enormous dimensions.

The inhabitants of Mars, if more advanced in astronomical knowledge than we, as one of our imaginative astronomers supposes they are, would have, in case they should desire to start an exchange of telegraphic communications with their earthly neighbours, to give their signals diameters of miles in every direction. But would they think of it ? The reciprocal question to this is the one that puzzles us. The earth, during all the oppositions of Mars, is in conjunction to it. It is lost in the rays of the sun, and invisible from Mars, unless it is in transit over the sun's disc. Then it is a little black, round spot, on which we have every reason to suppose the Martian astronomers will be able to distinguish nothing. The earth will be better situated at the quadratures, but also at a much greater distance.

We stop here, not desiring to discourage absolutely the candidate for the prize of one hundred thousand francs so generously and so imprudently offered to investigators. But the conclusion, which is sufficiently foreshadowed, is, that the problem of interplanetary communication is still far from solution ; and we believe we shall never be contradicted by real astronomers. We have faith in the indefinite progress of the science, while we are convinced that there are limits to this progress ; but we believe also that there is no profit in letting the imagination chase chimeras, and we are free to avow that the desired communication is such to our eyes.

THE EXTRAORDINARY POWER OF LIGHTNING.

Lightning entering loose sand has been known to form siliceous cylinders varying in length from a few feet to as much as 31, and with diameters varying from one to two and half inches. Two eminent scientists in Paris, aided by the most powerful battery in that city, were only able to produce in a mixture of powdered glass and salt a cylinder ·982 inches long and ·019 inches broad. They were unable to effect felspar and quartz. In striking a house lightning has been known to melt the electric wires, to fuse the gilding around picture frames, and to shatter a wall as if by gunpowder. Such is the awful power of lightning.

TO INVENTORS.—Anyone having a good Invention can, on applying to the Editor, "Science Siftings," obtain the advice and assistance of a well-known Patent Expert, free of charge.

INTELLIGENT ATOMS.

"My mind is not of a speculative order," said Mr. Edison recently to an interviewer; "it is essentially practical, and when I am making an experiment I think only of getting something useful, of making electricity perform work.

"I don't soar; I keep down pretty close to earth. Of course there are problems in life I can't help thinking about, but I don't try to study them out. It is necessary that they should be studied, and men fitted for that work are doing it. I am not fitted for it. I leave the theoretical study of electricity to the physicists, confining my work to the practical application of the force. It is my belief, however, that every atom of matter is intelligent, deriving energy from the primordial germ. The intelligence of man is, I take it, the sum of the intelligences of the atoms of which he is composed. Every atom has an intelligent power of selection and is always striving to get into harmonious relation with other atoms. The human body, I think, is maintained in its integrity by the intelligent persistence of its atoms, or rather by an agreement between the atoms so to persist. When the harmonious adjustment is destroyed the man dies, and the atoms seek other relations.

"I cannot regard the odour of decay but as the result of the efforts of the atoms to dissociate themselves; they want to get away and make new combinations. Man, therefore, may be regarded in some sort as a microcosm of atoms agreeing to constitute his life as long as order and discipline can be maintained. But of course, there is disaffection, rebellion and anarchy, leading eventually to death, and through death to new forms of life. For life I regard as indestructible. That is, if matter is indestructible.

"All matter lives and everything that lives possesses intelligence. Consider growing corn, for example. An atom of oxygen comes flying along the air. It seeks combination with other atoms and goes to the corn, not by chance, but by intention. It is seized by other atoms that need oxygen and is packed away in the corn where it can do its work. Now carbon, hydrogen, and oxygen enter into the composition of every organic substance in one form of arrangement or another. The formula CHO, in fact, is almost universal.

"Very well, then why does a free atom of carbon select any particular one out of fifty thousand or more possible positions unless it wants to? I cannot see how we can deny intelligence to this act of volition on the part of the atom. To say that one atom has an affinity for another is simply to use a big word. The atom is conscious if man is conscious, is intelligent if man is intelligent, exercises will power if man does, is, in its own little way, all that man is. We are told by geologists that in the earliest periods no form of life could exist on the earth.

"How do they know that? A crystal is devoid of this vital principle they say, and yet certain kinds of atoms invariably arrange themselves in a particular way to form a crystal. They did that in geological periods antedating the appearance of any form of life and have been doing it ever since in precisely the same way. Some crystals form in branches like a fern. Why is there not life in the growth of a crystal? Was the vital principle specially created at some particular period of the earth's history, or did it exist and control every atom of matter when the earth was molten? I cannot avoid the conclusion that all matter is composed of intelligent atoms and that life and mind are merely synonyms for the aggregation of atomic intelligence.

"Of course there is a source of energy. Nature is a perpetual motion machine, and perpetual motion implies a sustaining and impelling force."

THE MAN OF THE FUTURE.

That interesting topic, "The Future of Man," dealt with so effectively in our prize essay last week, teems with food for speculation. A correspondent observes that the probable further evolution of man is one full of interest to every speculative anthropologist. To him it is evident that man has by no means arrived at the acme of his development, either mentally, morally, or physically; indeed, he conceives the entire genus *homo* to be but little more than just started upon its career of evolutionary growth.

In the first place there are many species and sub-species of men upon the face of the globe of very low type that will either have to be, or will be, exterminated in time by some branch of what ultimately will persist as the dominant race. As examples, we may point to the pygmies of Africa, many of the North American Indians, and similar ferine tribes. Some of these, however, will undoubtedly to a certain extent fuse with the root-stocks of the dominant race; some may be assimilated entirely,—a fate that seems to await the negroes of the United States, and perhaps later the Japanese and others. In short, in the ages to come, the human species of this world may eventually form one homogenous race, and that race will speak but the one language. When that epoch has fully arrived, then indeed will the human species be fairly on the road towards its perfection. Multifarious tongues now stand as a prime factor in the way of man's more rapid evolvement. All this will require an enormous lapse of time, and when it arrives the face of the earth will be greatly changed. Man will have subordinated all things to his will—and nearly all other forms now existing, with the exception of the very few that may prove useful to man, will have been completely exterminated.

Many of these changes are now slowly advancing under our very eyes. Take the ideal man of the present day—one of the most perfectly organised ones as they now exist, and what do we find? In the vast majority of cases he is still subject to a variety of diseases which arise from the fact that, within a comparatively recent time of the world's history, he has assumed the erect attitude; has passed from quadrupedal to bipedal locomotion. Often these diseases prove to be fatal. Is there to be no improvement along this line? Again, he has still clinging to his organisation many of the structural vestiges that link him with the brutes: is there to be improvement in that direction? It has been proven that modifications are taking place in his dental armature, his dermal appendages (as the hair disappearing, and so forth), and perhaps to some extent in his very form, due to dress, as encasing the feet, and strapping certain parts of the body. Will these causes not, if continued, produce their ultimate effects?

However daintily he may mask the animals he kills and devours, he is still as carnivorous as most of the *Felidæ*. He often settles his disputes by the murder of masses of his kind, and the leaders in such assaults are glorified by having monuments erected to them in the high places. In these days such monuments are seventy-five per cent. more numerous than are those erected to the great among men of letters, of science, the arts, and the industries. All of this savours very strongly of savagery, and can hardly be characteristic of a fully-developed race of men.

This aspect is not improved when we come to think of the vast number of what many in the world would reckon as our best developed specimens of men, whose minds are still controlled by the nursery myths, the miracles, and the fables that were told and sung to the children of the early peoples of the world in Asia. Is the mind of the man of the future

to remain in such a condition of thraldom? In fact, the most of the opinions held, the institutions, the very language, the entire organisation by and of the best existing types of men, are each and all to be highly indicative of a very early stage of the development of the species.

Our correspondent cannot agree with the opinion that we may anticipate an increase in the average perfection of parts, and consequently a more harmonious development of man's present plan of structure, or that we cannot rationally look for any radical change in the plan itself. Although it would not demand any radical change in the *plan* of structure of present man, it has occurred to him that in the dim future of the world, the *environment* of man may have progressively so changed as ultimately to produce a race of enormous giants; or, other conditions obtaining, a race of the veriest pygmies may be the result? Who among our present-day naturalists, had he lived in Eocene time, and become familiar with the little *Eohippus*, no bigger than a fox, would ever have predicted that from it was in time to be developed the highly modified modern horse? It is safe to say, not one,—yet *Eohippus* must have appeared quite perfect for its kind in its day.

There is every reason to believe that in the lapse of time, or when many more millions of years have rolled by, our little earth will become cold from changes now going on; she may solidify to her very core, and become as frigid as a moon, and utterly incapable of supporting any manner of life upon her surface. In fact, life will probably be at an end long before any such condition in her comes about. The last one of the human species, the very last individual of all, the very tip of the last twig of the tree of human descendants, must also die—perish. If that modified form possesses sight, its eye may look upon a remarkable scene indeed. Earth may be stripped of all timber; coal beds all burned up; metals all moulded into medallions, machines, and monuments; her land-surface graded nearly or quite level by causes now in operation; every other living thing, every lion, lark, and louse in the land exterminated; and nothing remaining but the works of the modified man.

SOMETHING ABOUT SNOW.

The pure white lustre of snow is due to the fact that all the elementary colours of light are blended together in the radiance that is thrown off from the surface of the crystal. It is quite possible to examine the individual snow crystals in such a way as to detect these several colours before they are mingled together to constitute the compound impression of whiteness upon the eye. The snow is then clothed with all the varied hues of the rainbow. The soft whiteness of the snow is also in some degree referable to the large quantity of air which is entangled amid the frozen particles. Snow is composed of a great number of minute crystals. More than a thousand distinct forms of snow crystals have been enumerated by the various observers. One hundred and fifty-one were noticed during eight days in February and March, 1855, by Mr. Glashier, which were carefully drawn, engraved, and printed in a paper attached to the report of the British Meteorological Society for that year. These minute crystals and prisms reflect all the compound rays of which white light consists. Sheets of snow on the ground are known to reflect beautiful pink and blue tints under certain angles of sunshine, and to fling back so much light as to be painful to the eyes by day, and to guide the traveller, in the absence of moonshine, by night.

ANIMAL ADVANCE.

What we call institutions are only organised and hereditary instincts, and are common to man and the lower animals. The original social character of animals, which forms the basis of their institutions, is also the quality that renders them capable of domestication. Man simply takes advantage of this quality, and turns it to his own account by bringing the animal into his own domestic circle and service and making it a member of his household. In birds, for example, the conjugal instinct is remarkably strong, or as we would say in speaking of human relations, the institution of marriage, either in its monogamous or polygamous form, is firmly established and highly developed, and forms the foundation of a well ordered domestic and social life. The paternal fox trains his young with as much care and conscientiousness as any human father; the beaver constructs his habitation with the foresight of a military engineer and the skill of an experienced architect; the bee lives in well-regulated communities, forms states, and founds colonies; and the ant not only cultivates the soil, plants crops, gathers in the fruits of his labour and stores them for future use, and keeps other insects as domestic cattle, but shares also the vicious propensities and domineering disposition of man, waging war on creatures of his own species and holding his prisoners as slaves. These habits or customs have the same origin and character in the lower animals as in man, being in both cases products of evolution and undergoing modifications from generation to generation. Animal, not less than human, societies are governed by their laws and traditions, and preserve a sort of historical continuity by which past and present are bound together in a certain orderly sequence. Bee-hives which suffer from over population, rear a queen and send forth with her a swarm of emigrants to colonise, and the relations of the mother-hive to her colonies are known to be much closer and more cordial than those which she sustains to apian communities with which she has no genetic connection. Here the ties of kinship are as strong and clearly recognised as they are between consanguineous tribes of men.

Again, the statement that animal habits are fixed, and human customs variable and improbable, is true only to a very limited extent. Closer observation has shown the latter to be more stable and the former more mutable than is generally imagined, especially if we compare the highest orders of animals with the lowest human tribes. In primitive society and among savage races customs remain the same for countless generations, and seem to be quite as persistent and incapable of change as animal instincts. Not only do animals, often in the course of a comparatively short period, undergo marvellous transformations both of mind and body, through the force of natural selection or by careful interbreeding, but they were also led by circumstances and through forethought to make conscious and intentional changes in their manner of life.

It is curious to note the variety of characteristics distinguishing members of the same family or genus. Thus, the European cuckoo lays her eggs in the nests of other birds, and leads the life of a shiftless parasite and shameless polyandrous vagabond. The American cuckoo, on the contrary, has not yet learned to shirk her maternal duties and domestic responsibilities, but like an honest and thrifty housewife and conscientious mother, hatches her own eggs and rears her own young. The South African and Australasian representatives of the *cuculinæ* follow, in this respect, the habits of the European bird. There is also a species of *molothrus*, which sometimes begins but seldoms finishes a

nest, like the hypothetical man in the parable, who would fain build without first sitting down to count the cost. She is seized occasionally with a spasm of virtuous endeavour in this direction, but soon yields to the greater comfort and convenience of imposing upon others the burden of brooding and nurturing her offspring. Evidently she turns the matter over in her mind, and like Rousseau, reasons herself into the belief that it is better not to assume any family cares, but to cast her children as foundlings upon the bosom of public charity. "There are goldfinches, thrushes, fly-catchers, cardinal grossbeaks, and other fussy motherly fowl," she seems to say, "willing enough to undertake the charge; why not gratify their low philoprogenitive passion, and thus enable me to devote myself to more congenial pursuits!" Still another kind of *molothrus* leads the life of a squatter, never building a nest of her own, but brooding in the abandoned nest of some other bird. Many birds have, within the memory of man, made considerable advances in architectural skill, and adopted new and improved methods of constructing their nests. This progress has been observed especially in California, and in all cases the young profit from the knowledge acquired by their parents, and the improvement becomes a permanent possession of the race. In places where they are particulary exposed to the attacks of pugnacious sparrows, they have been known to close the opening in front of their nests and make the entrance on the back near the wall. In some instances this purely precautionary and defensive change of structure, after its efficiency has been tested in a single nest, has been adopted by the swallows of an entire district. Orioles, finding that the bough from which they have suspended their nest is too slight to sustain the weight of the full brood, attach it by a long string to the branch above, fastening it securely by a number of turns and a knot. It would be difficult to say in what respect the mental process leading to the adoption of such a mechanical contrivance differs from that which causes an architect to buttress a weak wall. The same bird, in some latitudes, now uses yarn and worsted instead of vegetable fibre for its nest, but it always selects for this purpose the least conspicuous colours, such as grey and drab; and yet the bird's gorgeous plumage is proof, according to the theory of sexual attraction, that bright colours are pleasing to it. Here we have an example of æsthetic pleasure being subordinated to considerations of safety; the prudent oriole, notwithstanding its fondness for resplendent hues, choosing those colours which render its nest less visible and more difficult to discover, and rejecting those which, in other respects, are more gratifying to its fancy,

The tailor-bird of East India used to stitch the leaves of its nest together with fine grass, horse-hair and threads, which it twisted out of wool; since the introduction of British manufactures it uses sewing-thread and the filaments of textile fabrics, except in remote regions, where the ingenious bird still works on in the primitive way. So, too, in America, birds in constructing their nests everywhere turn to their account the products of human industry and keep abreast with the progress of the age. The materials employed correspond to the contemporary state of civilisation, and mark the periods of industrial development through which the human race has passed. The wagtails, in a watch-making district of Switzerland, have learned to build their nests of fine steel shavings; a nest of this kind, if preserved, would indicate to the inhabitants of that country a thousand years hence the kind of industry that was carried on by their ancestors. Sparrows, which usually build in chinks of walls or under roofs, if forced to build their nests in trees or other unsheltered places, cover them with a sort of hood to keep out the rain. These facts, and many others which might be adduced, suffice to prove that animals avail themselves of new discoveries and easier methods in order to increase the comforts and conveniences of life. Even instincts, which seem firmly rooted and are regarded as characteristic of the class, are by no means so persistent as is commonly supposed. The individual inherits, but soon loses them if they are not brought into early exercise. A duck or gosling, if reared in the house until it is two or three months old, has no greater liking for the water than a chicken, and if thrown into a pond will scramble out, showing signs of great fear of the element to which its webb-feet are particularly adapted. An artificially hatched chicken does not attach itself to a hen more than to any other animal, but follows its first associate, a child, a cat, or a dog.

Buffon denies that animals are susceptible of what he calls "the perfectibility of the species." "They are to-day," he says, "what they always have been, and always will be, and nothing more; because as their education is purely individual, they can only transmit to their young what they themselves have received from their parents. Man, on the other hand, inherits the culture of ages and gathers and conserves the wisdom of successive generations, and may thus profit by every advance of the race, and, in turn, aid in perfecting it more and more." This assertion has been repeated by scientists of the old school as though it were an axiom of natural history, instead of an arrogant anthropocentric assumption refuted by scores of well authenticated facts. The whole process of domestication, which is to the lower animals what civilisation is to man, and the possibility of producing and propagating desirable qualities in the race, run counter to Buffon's theory. The value of a horse's pedigree depends upon the transmissibility of distinctive characteristics which were originally peculiar to some individual horse, idiosyncrasies which commended themselves to man as worthy of preservation, or such as in the natural struggle for existence would assert and propagate themselves. If the descendants of blood-horses do not inherit the individual training of their sires, neither are the children of scholars or musicians born with a knowledge of books or the ability to play on musical instruments. What is inherited in both cases is some particular disposition or endowment, a superior aptitude for the things in which their progenitors excelled. Indeed, this heritage is handed down in horses with surer and steadier increase, or at least, with smaller loss and depreciation than in human beings, since they are mated with sole reference to this result; and there is no room left for the play of personal fancy and caprice, or for social, sentimental, or pecuniary considerations, which exert a baneful influence upon marriage from a physiological point of view, and contribute to the deterioration of the race. This is strikingly perceptible in some portions of Europe, where the struggle for existence, and especially for high social position, is exceedingly intense, and a large dower suffices to cover up all mental and physical deficiencies in the bride. It is by the selection not only of the finest stock, but also of the choicest individuals for breeding, that animals are "progressively improved" both bodily and intellectually. This is, perhaps, most clearly observable in hunting-dogs and race-horses, which have undergone quite remarkable modifications within the present century owing to the extraordinary pains taken to develop and perfect their peculiar characteristics. In some instances unusual births or freaks of nature are preserved, and by persistently propagating themselves form the starting point of new species. A striking example of this perpetuation of individual peculiarities is the short-legged and long-backed Ancon sheep, a comparatively recent product of Nature rendered perma-

nent by the care of man. A pointer, greyhound, or collie inherits and transmits to its offspring not only race attributes, but also acquired aptitudes in the same manner and to the same degree as a human being does who is distinguished for some special faculty. There are prodigies of dogs which do not beget prodigies of puppies, just as there are men of genius whose children are by no means eminent for their intellectual endowments.

(*To be concluded in our next.*)

SIFTINGS OF THE STUDY.

Scientific "Mysteries."

(London: "The Chemist and Druggist," 42, Cannon-street.)

This is a most useful and interesting book containing a number of chemical and optical illusions, with practical details for experimenting in an effective and inexpensive fashion. There is also an introduction to ancient and modern chemistry. Young scientists will find many of the phenomena that have puzzled them when displayed by the adept hands of professionals, now amply illustrated and easy of reproduction. Much parlour amusement may be obtained during this season of dark evenings by these means.

Last Year.

(London: S. H. E. Foxwell, Temple Chambers.)

The events of 1891 are detailed in "Last Year" in a very graphic manner, considering that the utility of such a compendium depends on the manner in which it is condensed. It is carefully and impartially compiled throughout, and will be found eminently useful as a book of reference, as well as readable by those who only desire to refresh the memory about the occurrences of the past year.

We have received a copy of Mr. J. Fallowfield's "Photographic Remembrancer" for January. An interesting item is the comparison of the prices of photographic chemicals in the years 1856 and this present year of grace. If Mr. Fallowfield's figures are correct, which it appears to us from a cursory glance they are, the difference on some of the photographic chemicals between then and now is something like 1,600 per cent. Mr. Fallowfield's "Remembrancer" is always interesting, and thoroughly up to date.

The Photographer's Diary, for 1892, (James Blackmore, 55, Chancery-lane) marks the third year of this excellent publication, and there can be no doubt that in point of utility it beats any of its predecessors. It is replete with instructions, formulæ, and other welcome information to the professional and amateur photographer.

When the mosque of St. Sophia, in Constantinople, was built, more than 1000 years ago, the stone and brick were laid in mortar and mixed with a solution of musk, and the building, it is said, has been infected with the odour ever since. Probably age has imparted a musty odour, from which the musk story was fabricated.

A sergeant, a lance-corporal, and a private of the balloon detachment of a Berlin regiment had a very dangerous journey lately. They went up at noon, intending to go to Hamburg, but at the height of 7000 feet they got into a terrific hurricane at a temperature of 11° below zero (Centigrade), and were driven to Thuringia, where they landed about four o'clock.

EVOLUTION AND ANTI-EVOLUTIONISTS.

The doctrine of evolution teaches that the changes which take place in the universe both of mind and matter follow an orderly sequence, and that each preceding stage potentially contains the succeeding one—that every succeeding change can only be explained and understood through a comprehension of the preceding one. It incites us, therefore, to a study of cause and effect, and encourages us to believe in the possibly of a rational interpretation of Nature. Strictly speaking, evolution is nothing more than a generalisation of the idea of cause. Every man within certain limits is an evolutionist, and we have little hesitation in saying that the limits within which each man is an evolutionist are the real limits of his intelligence. Where he ceases to be an evolutionist he resigns all attempt to comprehend, and merely records his acceptance of unexplained facts. In the sphere of human history the principal of evolution seems to be fully recognised. The historian who would fold his hands and turn up his eyes before any given event, and say that it was utterly incomprehensible, having no relation, save the abstract one of time, to previous or subsequent events, would be scorned by every intelligent reader. Not to be able fully to explain a historical occurrence is one thing; to say that it has no dependence on previous conditions is another and very different thing. We look to the historian to attack such problems with a view to bringing them under the operation of some law of historical development; in other words, we believe fully in evolution as applied to the social and political history of mankind.

Similarly we believe—and when we say "we," we mean all persons with any pretensions to education or intelligence—in evolution as applied to the physical history of our globe. We believe that it passed through successive stages or phases, each of which prepared the way for the one following. Evolution is the central idea of geology. It is this idea alone which makes geology a distinct science. This is the cohesive principal which unites and gives cohesion to all the scattered facts of geology; which cements what would otherwise be a mere incoherent pile of rubbish into a solid and substantial edifice. That the Silurian age passed naturally into the Devonian, which served as a transition to the carboniferous, no one who has given any thought to the subject for a moment doubts. The trouble arises when it is proposed to consider successive animal species as genetically connected. The scientific world at large has no difficulty in framing the conception or in adopting the idea, but to a few scientific men and a multitude of non-scientific persons there is impiety in the suggestion that one animal species—or one plant species, for that matter—could possibly have passed into or given birth to another. The creation of species was an office which their theology had reserved for a supernatural being, and they can not assign to natural causes or processes the honour of introducing to existence so much as the tiniest parasite. Whatever is most hideous, uncouth, destructive, and loathsome in the animal kingdom must be regarded as the special and intentional production of Divine Wisdom no less than the noblest forms of life. None the less do men set themselves to destroy whatever in creation they find hurtful or inconvenient; in practically dealing with plants and animals they ask—not, "Did Divine Wisdom create it for a wise purpose?" but "Does it suit our interests to allow it to exist"

The great weakness of the assailants of evolution is that they do not offer so much as the germ of an instructive or helpful idea in the place of that which they oppose and would fain subvert. Admitting that there has been much

of error in connection with the speculations of the evolutionist school, the error, we contend, has been of a healthful kind. An ancient Greek philosopher held that what was of chief importance in a scientific theory was, not that it should be in exact accordance with facts, but that it should be based on belief in a natural sequence of phenomena. Anything, he said, rather than non-natural, the irrational, the arbitrary—in a word, anything rather than superstition. And he was right; for the man who is taught to believe in natural causes, studies natural causes; and if, at a given moment, he attributes to them wrong effects, his further observations will in due time cure him of his error. Thus the errors of the evolutionists are sure to be discovered and corrected, for they consist, and can consist only in wrong suppositions as to the relation, between material phenomena—phenomena which are open to the study of all and which have no habit of hiding themselves behind a veil of mystery. But what remedy is there for the errors of superstition? What can we say to the man who believes in the uncaused, to whom the universe is full of facts that bear on them no stamp save that of arbitrary will? His superstition is a pillar round which reason will chase him in vain.

To say that every vegetable and animal species is the special result of a distinct divine fiat is to put a veto upon all scientific inquiry in the region of biology. But to-day such a veto comes too late. The world has learned too much under the guidance of the doctrine of evolution, too many regions of knowledge have been fertilised by it, too many individual minds have found in it a never-failing spring of instruction and intellectual stimulation, for any overthrow, or even any obscuration, of the idea to be possible. What, we ask, have its opponents to teach? They are compelled to recognise the general principle of evolution in history, geology, and many other fields of research, and, so far as they do, their intelligence has free scope. But what do they teach instead of it in the field of biology? Absolutely nothing. They simply draw a line and say, "Here begin wonder, miracle, mystery, all that is arbitrary and thought-confounding." To the opponent of evolution the resemblances, analogies, and homologies that run through animated nature are simply so many false lights, *ignes fatui*, suggesting community of origin where community of origin there is none. Rudimentary organs signify nothing, neither do the facts of embryology. That it is anti-scientific, and that it tends to nothing less than paralysis of the intellectual powers, is evident at a glance. Evolutionists may proceed very contentedly with their studies. They are in the right path, because they believe in the universality of natural causation; and, if they fall into error, they will work their way out again without any abandonment of their cardinal principle.

A WONDERFUL example of patience in the Chinese is afforded by a consular report dealing with the manufacture of salt in Central China. Holes about 6 inches in diameter are bored in the rock by means of a primitive form of iron drill, and sometimes a period of forty years elapses before the coveted brine is reached, so that the work is carried on from one generation to another. During this time the boring, as may be imagined, goes down to an immense depth. When brine is found it is drawn up in bamboo tubes by a rope working over a large drum turned by bullocks. The brine is evaporated in iron caldrons, the heat being supplied by natural gas, which is generally found in the vicinity of the salt wells.

MUST OUR SAILORS GO?

If the blue-jacket is to be superseded to a very large extent, as now seems likely, by the machinist, then the navigating officer must needs learn to handle machinery or be displaced by an engineer who has learned navigation and gunnery. For the modern war ship has come to be a machine, or, rather, a collection of machines; her masts, if she have any, of the "military" type, with no yards across and barren of sails, topped only with nests for observation and light batteries. To place such a craft under the command of a sailor is like putting a sailing ship in command of a machinist.

If, however, it should still be found advisable to continue the system of a general executive without special engineering training to command a ship, a radical change will undoubtedly be required in the present practice of rating of line and staff, at least where engineer officers are concerned; nor is it likely that the present rule debarring them from command outside the engine room, that is to say, "on deck," will be found much longer practicable. It is now clearly seen that low rating, low pay, and small consideration are driving the really desirable engineers ashore, where the demand for engineering skill is active, and the compensation commensurate with ability. A naval engineering authority dwells upon this in a recent report, protesting that there is not a sufficient force of engineers in the service at the present time to properly care for and direct the working of the engines.

Marine engineering means much more now than formerly; the engines are more complicated in design, the pumping machinery, and that to work the guns and steering gear demand expert attention. The chief engineer of a modern war ship must be able quickly to detect the symptoms of uneven running and apply a ready relief; he must be able to make all kinds of ordinary repairs, not only in the main engines, but as well in the condensers, the pumps, the steering apparatus, and gun-operating devices. To do this effectively requires a liberal education in mechanics, including a knowledge of designing and mathematics. To put an enginner thus equipped under such petty restraints as is now the practice in the navy is, to say the least, unreasonable. Why should he be compelled to ask permission of an officer, unfamiliar with engineering, if he may draw a bolt, drive a rivet or the like? Yet under the present rules he must do so; a chief engineer was recently placed under arrest for such an infraction of the rules, and though an apology was made to him, the emergency being shown to have existed and the machining requisite and necessary, the rule still stands, and he can be arrested again when he repeats the so-called offence against good order and discipline.

In the merchant marine service, notably on the big modern passenger steamers in the trans-atlantic trade, the importance of the master or "captain," as he is called by the passengers and crew, and the inconsequence by contrast of the chief engineer, seems quite as absurd. The captain is said to "work" the ship, but really the work consists principally of calculating the running of the ship from noon to noon, a simple task, since they run most of the way on the same parallel of latitude, and the change in longitude is denoted by the difference between the ship's time and Greenwich time as given by the chronometer. On the broad seas, where an error of five miles or more short or long of the course is of little consequence, nothing like so much skill in navigation is required as in the coasting trade, for when the sea-going steamer approaches the land, a pilot is taken aboard. The engineer, on the other hand, has the whole burden of the

ship's progress placed upon his shoulders ; it rests with him whether the ship shall make slow time or fast time, and when any part of the complicated machinery breaks down, it is to his skill alone that all must look for succour.

And so in heavy weather, when passengers inquire anxiously of the captain as to the chances, he has little or nothing to base an estimate upon, though he may look ever so wise, for he cannot know the conditions of the engine's working or the stress thereof, and instead of hazarding an opinion, he would do much better to reply, "I'll just step below and ask the engineer—he knows."

FEEDING THE SICK.

It is a fact beyond all question that there is a progressive loss in weight in all cases of acute sickness until a normal appetite is regained or death occurs. Not all the resources of medical science have thus for served, perhaps, in the least, to avert this loss.

If foods cannot be so "handled" by the sick as to prevent this waste, is it not barely possible that they are not digested and assimilated ? Is not this inference still stronger in the light of the numerous cases on record (and in the experience of every physician) where life has been sustained for very long periods without any ability to take food, perfect recoveries ultimately occuring ?

Either nature has been guilty of an enormous blunder in causing such intense aversion to all ordinary foods, when the need to "support the strength" seems so pressing, or enforced feeding is a blunder.

Except in the use of milk, it is not possible to administer any food in quantities to meet the seeming need. But is milk a fit food for any case of severe sickness or in any case where the appetite is lost? It is safe to assert that not a hundred families in this country would or could object to its use in any case when prescribed by a physician. It is, perhaps, as safe to assert that not a hundred intelligent families would *not* object to giving their sick the equivalent of the milk ration in tough curds, *swallowed whole*. Milk is reduced to the form of tough curds at one stage of digestion ; hence it would seem that it should always be administered, if at all, in this form to the sick in order to be duly masticated ; fine particles certainly being more easily digestible than large masses. But who would give curds to the sick, even if milk is the highest type of food, and particularly if they have been soaked in brandy or whisky ? There is nothing in curds or even in milk that appeals to the sense of *taste* in a well-marked case of hunger. No one, not even the strongest, could enter upon a course of diet of milk or milk and whisky or brandy without an immediate impairment of strength, because of its difficulty of digestion. Is a stomach enfeebled by a general disease any better able to so digest as to maintain strength ?

The writer has not given milk in any case of acute sickness for many years. This withheld, there is little danger of other foods being enforced to an undue taxing of the stomach ; the uniform aversion to all solids being the safeguard. He has found it entirely safe, even in fevers, to await the normal appetite before feeding ; the reliance for maintaining the strength being on the tissues, aided by such drinks as nature calls for with no obscure language. And a striking thing has been observed in cases so treated, and that is, an increase of strength as the acute symptoms subside, and while still on tissue support. Whatever of seeming absurdity there may be in this statement, the fact is clearly within easy reach of demonstration by any who have care of the sick.

A rigid adherence to this method has not been attended by such fatality as to excite public attention.

THE EXTERMINATION OF ANIMALS.

Extermination is defined in Nature as indicating that in certain parts of the range of a species, whether plant or animal, it has ceased to exist, however abundant it may remain elsewhere ; while in other cases, especially if the species have but a limited distribution, it easily becomes equivalent to extirpation. The older school of zoölogists seems hardly to have contemplated the possibility of a whole species having become extinct within the period since man appeared upon earth, or to have supposed that a species could by human efforts be utterly swept away. Thus there was once scepticism about the extinction of the dodo, or, that having been established, about its having existed within the human period. The disappearance of numerous animals, formerly abundant, from the settled parts of our country, affords examples of local extinction ; and the fate of the buffalo threatens to furnish an instance of total extinction by the agency of man. Man's agency usually acts indirectly—as by changing the conditions of the country, so as to make them unfavourable to the subsistence of certain animals, rather than directly by killing all the individuals of a species outright. The wolf has defied all efforts, by offering bounties and otherwise, to accomplish its destruction in Europe, except in artificially-built-up Holland, where it never was at home ; Denmark, every spot of which is accessible to the hunter ; and the United Kingdom, where its forest resorts have been removed. Other instances are the extirpation of the quail in New Zealand by means of fires that were lighted for other purposes ; the threatened destruction of other interesting animals of Australia and New Zealand by animals of the weasel kind that were introduced to prey upon the imported rabbits ; and the destruction of turkey-buzzards' eggs and petrels in Jamaica by the mongooses that were taken there to make war upon rats ; of the *Diablotin* petrel of Dominica by a species of opossum ; and the destruction of the *cahows* in the Bermudas, till it is not known now whether the bird exists there. The great *skua*, or "bonxie," disappeared from one of its three breeding-stations in the Shetland Islands several years ago, and has been maintained at the other two only through the vigorous exertions, to repress poachers and preserve it, of the late Dr. Robert Scott and the late Dr. Lawrence Edmondston, respectively. The Zoölogical Society has ordered medals struck in honour of the services these gentlemen rendered to science. Though the reward is posthumous, and goes to the heirs of the well-doers instead of to themselves, the acknowledgment is a fitting one, marks an example, and is an encouragement to the lovers of living nature.

A NEW METHOD OF PRODUCING LIGHT.

In connection with the research that is being made into the problem of the production of light by other means than by combustion, it is of interest to remark some of the experiments of M. Moissan upon the gaseous element fluorine, which he has recently succeeded in isolating. Fluorine seems to answer to that ideal conception of the old alchemists—the universal solvent. It possesses most intense chemical activity. The gas is obtained by electrolysis, conducted under a variety of ingeniously devised conditions necessitated by the corrosive nature of the product. Many different sorts of flames are produced by allowing fluorine gas to come into contact with other elements. With hydrogen, combination takes place explosively even at a temperature of —23°, and in the dark. If a tube delivers fluorine into an atmosphere of hydrogen, a very hot blue flame, bordered with red, at once appears at the end of the tube. Bromine vapour com-

bines with fluorine in the cold, with production of a very bright, but low-temperature flame. Iodine gives a pale flame; phosphorus and arsenic combine with fluorine with lively incandescence. Carbon in a finely divided state combines with fluorine even at ordinary temperatures. Purified lamp-black inflames instantly with great brilliancy, as do also the lighter varieties of wood charcoal. The amorphous variety of boron likewise ignites instantly in fluorine, with projection of brilliant sparks; but the most beautiful of all these extraordinary displays of chemical activity is the reaction between fluorine and silicon. The cold crystals immediately become white hot, and then burn with a very hot flame, scattering showers of stars in all directions. Many other substances burn in fluorine, according to details published by M. Moissan in the *Annales de Chimie et de Physique*. The reason for some of the flames produced being of low temperature, though of high illuminating power, is a matter demanding further investigation.

A PROFESSOR remarks that electrical science has made a greater advance in the last 20 years than in all the 6,000 historic years preceding. More is discovered in one day now than in 1,000 years formerly.

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SCIENCE NEWS AND NOTES.

"Ah! surely nothing dies, but something mourns."—BYRON.

A Remarkable and Interesting Phenomenon

was observed at Douglas, N.B., last month, and became public through a letter addressed to the *Glasgow Herald*. While two gentlemen were walking in the midst of a driving hail shower they were surprised to find that their umbrellas, which they had up, had a glow of fire at each steel point of the framework, closely resembling the glow of a highly-charged frictional electrical machine in a dark room. They ask the question if this was a miniature St. Elmo's fire, caused by the electrical state of the atmosphere consequent on the discharge of the overhanging cloud by the hail; or was it simply that the umbrellas were charged with electricity by the friction of the hail against the silk?

A Similar Hypothesis

to account for the phenomenon is sent to us by a correspondent, Mr. H. M. Campbell, of 29, Dixon-avenue, Glasgow. He is of opinion that the cloud of aqueous vapour from which the hailstones initially fell was highly charged with electricity, and in the process of condensation or congelation the drops of water or crystals carried with them part of the charge, which charge was individually retained by the drops or crystals during those changes incidental to their passage through zones of the atmosphere of different temperatures. Then, falling upon the uplifted umbrellas, and rolling over the damp covers thereof, the hailstones easily parted with their electrical charges to the silk. If the insulating materials at the junction of the silk with the handles were sufficiently dry as to offer a higher resistance than that of air to the passage of electricity, then, accumulating with great density at the points, the electricity was discharged therefrom by convection, the glow observed being due to heat produced by the disturbance of air molecules i the immediate vicinity of the points.

Whence the World's Warmth?

was the title of an article that recently appeared in our columns. Mr. Ernest Howden, of Haverland House, Wakefield, now writes :—"If the sun does not give us heat direct, as we have been before taught, and is 'a frozen mass eternal,' I should like to ask a question, and that is, 'Whence the world's light?' for certainly I have never heard of light being produced at many hundreds of degrees below zero. The intense 'local heat' spoken of in the article cannot surely be sufficient to give us our present light. I must tell you, Mr. Editor, that I am not an astronomer, but only an 'ordinary reader' of your most valuable paper, and on reading the above-named article, the thought, 'Whence the world's light,' happened to strike me." We would remind our correspondent that the article referred to was only an hypothesis emanating from the ingenious brain of an American philosopher—we will not say astronomer. We published it because it contained much interesting reasoning, and theoretical science has done so much to advance our knowledge of real science. For our part, we naturally believe that the world owes its light and heat, apart from incidental causes, to the sun and other stars.

A New Motive Power

has been applied by M. Susini, in France, who claims to have made a practicable engine for using a liquid—such as ether—boiling at a low temperature, and he believes, with the characteristic confidence of an inventor, that this must lead to a complete revolution in the construction of the marine engine at least. The ether is vapourised and condensed repeatedly without loss. Such an engine offers the advantages of lightening boats and locomotives by making the load of water for the boilers unnecessary, and of avoiding the risk arising from boiler incrustation. Another advantage in many cases, such as that of war vessels required to start at a short notice, is the quickness with which pressure may be obtained, and the machinery put in motion. The ordinary economy of the ether engine has not been determined, but it has been employed in connection with a steam engine, and, by using the heat of the waste steam, has given a considerable increase of power without additional fuel.

Silk-weaving by Electricity

has been put to a successful trial in Germany. Two looms were put in motion, the result being that the working by electricity was more satisfactory than that by means of caloric engines or gas motors, and the swinging masses, otherwise necessary for the working on a small scale, can be entirely dispensed with. The results named show that house industry could easily be made to flourish by the transmission of electric power.

The Hygiene of Artificial Teeth

has aroused the attention of the *Lancet*. It is common experience amongst dentists that a very large majority of artificial dentures worn are discoloured and by no means devoid of unpleasant odour. This lack of cleanliness, which arises sometimes from neglect, but often from want of instruction on the part of the dentist as to the necessary *modus operandi*, is, our contemporary tells us, a fruitful cause of inflammatory conditions. Débris of food mixed with saliva and mucus accumulating on a plate rapidly undergo decomposition, with the result of irritating the mucous membrane and producing a general inflammation of the oral cavity. The oral secretions become altered and vitiated so as to cause dyspepsia, and caries of the remaining natural teeth is set up, which proceeds with great rapidity, especially in "clasp" dentures, not from the friction, but because the inside of the clasps most generally escape the brush. The materials used in the construction of artificial dentures differ widely in their effect upon the tissues with which they come in contact. A larger number of cases of inflammation of the oral tissues occur where vulcanite is used as a basis than with gold or other metals, and so prevalent is this inflammation in the case of vulcanite that it has received the distinctive appellation of "rubber sore mouth." Several reasons have been assigned for the effects produced by vulcanite. Nearly all this material is coloured with mercuric sulphide (vermillion), which ingredient has been accused of being the cause of trouble; but an exhaustive investigation did not substantiate this view, one particular point being that "rubber sore mouth" often occurred where black rubber was used, which contains no vermillion. The porosity of vulcanite, especially when not sufficiently vulcanised, renders it liable to retain deleterious material if not kept scrupulously clean.

Indian Jugglery

was recently the subject of much interesting press discussion. One party took the view that it is only clever legerdemain, and the other that the remarkable feats are due to the occult or hypnotism. The particular trick that excited all this controversy was the celebrated mango delusion. Among others, Dr. Andrew Wilson maintained that it was unsafe to assume the inexplicable theory of matters until we had exhausted the probabilities which lie at our doors; and he said the same thing concerning a recent "boom" in ghosts and ghost-seeing. Most things come to those who live long enough to wait, and, after the receipt of many letters regarding Indian jugglery, Dr. Wilson tells us that he has at last been favoured with what he thinks is the true explanation of the mango trick. This trick consists in the juggler causing a mango plant to grow out of a pot containing earth, amid which a mango seed has been planted. As far as he can discover, there exist various modifications of the trick; for some correspondents declare that it is not a mango which grows out of the pot, but only a branch of some tree which the juggler has plucked off close by the scene of his operations. The typical trick, however, shows a mango plant growing bit by bit as the juggler performs.

An Old Anglo-Indian

now writes that he does not agree with the explanation of Herr Hermann, who said the growing-plant trick was performed through the performer concealing the pot, with the plant in it, under his robe. In 1865 this correspondent was on the point of leaving Calcutta, when some native jugglers came on board the steamer to give an exhibition of their powers. The surroundings were thus very unfavourable for the performance of anything but a very dexterous trick, and the mango exhibition was given on the bare deck. The performer was almost naked, so that there was no opportunity for the concealment of a flower pot under a robe. He placed before him, first of all, a small flat native wicker-work basket such as snakes are carried in. This was filled with earth. A mango seed was then produced. It was a very large one—a point, this, of importance in view of what follows—and was duly placed in the earth and covered up. The earth was watered, and the basket in its turn concealed by a small cotton cloth. Then began the usual mutterings and incantations, while the earth was again sprinkled with water and stirred with the fingers of the operator. After a few minutes' interval the juggler lifted the cloth and showed to the spectators two small mango leaves appearing above the surface of the earth.

The Basket was once more Covered up,

the watering of the earth and the incantations proceeded, and, in a short time, when the cloth was removed, a mango plant, seven inches or eight inches high, and bearing four or five leaves, was disclosed to view. After another interval, a seedling mango appeared, at least thirteen inches high, and bearing seven or eight leaves. Here the performance ended. Curiosity was rife, of course, regarding the juggler's *modus operandi*, and Dr. Wilson's correspondent, anxious to know how the trick was performed, offered the juggler a good round sum of money for the disclosure of his secret. After some hesitation, the man consented to reveal his art, stipulating that his revelation should be conducted in a secluded spot. A cabin on the ship was offered and accepted as a suitable place, and the juggler and his questioner retired thereto. The basket was prepared as before, and the mango seed was handed round. It was, as before, a large one. On its being returned to the juggler, he pressed one end of the seed with his long finger-nail, when the seed opened. Two small leaves, those first seen in the deck-trick, were then withdrawn from the seed, and next in order came forth the stem, with four leaves. Ultimately, the full thirteen inches of the plant were manipulated out of the seed before the eyes of the spectators. The seed was, in fact, a hollow one, and the young plant had been dexterously folded within its compass. It is the art of folding the plant inside the seed which constitutes the essence of the trick.

A Simple Experiment

shows how the conditions of this trick can be realised, and for ever disproves any connection between it and occult science. Most leaves can be so folded that, when liberated from pressure, they spring back to their original shape. The folding, however, must be done in a special and careful manner. The *upper* surface of the leaf must be folded on itself, and that surface, skilfully treated and watered, will scarcely show a crease on a superficial examination. The creasing which the under surface will show is, of course, concealed from the spectator's view. If the fruit is produced in the course of the trick, our informant conjectures, it also is contained in the hollow seed. It is likely to be a very small mango, which is packed in a dried state, and which, under the

watering process, swells out to considerable proportions. We owe much to Dr. Wilson for the perseverance he has shown in unravelling this mystery.

A Curious Cause of Electrical Faults

has been discovered by the London Electric Supply Company. The company finds that where it uses concentric wires faults suddenly occur. These are found to be due to mice making contact between the earth and the insulated high-pressure terminal. A current passes and blows the the fuse, and the burned remains of the mouse are found. Probably mice are attracted by the warmth of the transformers, which, when not too hot, also attracts beetles and other insects. When the mice get near the high-pressure terminal there is an electrostatic force which acts on their antennæ. This attracts their attention, and they investigate the terminal and find that, whether knowledge comes after death or not, death is apt to come first.

Elephant Breeding

has never, within the memory of man, seriously engaged attention. We now learn, however, that a Mr. Newbury, of California, is enthusiastic over a project he is about to carry out for starting an elephant ranche in that state. He proposes cultivating the elephant for its meat and its capacity for hard and diversified work. He says that "as an article of food the elephant is superior to the horse," and most people will be willing to accept his statement, though not fully appreciating its force. He says that behind a tough exterior it hides a tender steak, and that African explorers are profuse in their praise of elephant cutlets. A full-grown elephant weighs about 7,000 pounds, and Mr. Newbury counts 6,000 of this as good meat. He is going to train the elephant to pick oranges and hire them out to orange growers.

Ships are not now Struck by Lightning

nearly as frequently as when wooden vessels were so much in vogue. This has been noticed even under the tropics, where violent storms are very frequent. According to some returns made of the statistics that have been accumulated since 1879, by the German authorities, this must be attributed to the general use that is now made of wire rope for rigging purposes, as well as to the fact that the hulls of ships are usually constructed of iron or steel. Thus the whole ship forms an excellent and continuous conductor, by means of which the electricity is led away into the ocean before it has time to do any, or serious, damage. Captain Dinklap, of the German Navy, who has had charge of the commission appointed to investigate this question, states that no case has been recorded where a ship rigged with wire rigging has sustained any damage from lightning, except in a few instances where continuous connection had not been made with the hull. But wooden ships, rigged with ordinary rope rigging, still show the same percentage of casualties as formerly, when they are not fitted with lightning rods, and when the proper precautions are not taken to maintain their efficiency.

The Flesh of Poisoned Animals

would, by most people, be considered unfit for human food, but Herr Schmidt Mulheim, who has made a careful study of the subject, thinks differently. As reported, moreover, in the *Revista Internazionale d'Igiene* of Naples, for June, 1891, it may be used without any danger whatever. Many savage races constantly use the flesh of the animals that have been killed with poisoned weapons, and have never been injured by that means. Harms has proved (*Univ. Med. Mag.*) tha the flesh of animals that have been poisoned with nux vomica, and with tartarised antimony, is not at all hurtful; Feser has demonstrated the same fact in regard to strychnine and eserine; Spallanzani, Zappi, and Sonnenschein have done the same for arsenic. Froehner and Knudson have made some experiments for this purpose with strychnine and with eserine. They fed dogs with large quantities of mutton poisoned with strychnine and eserine, and they found that no injury whatever was done to the animals. Besides, they themselves ate some of the poisoned meat and drank soup made from it, and found that the flavour was good and had no injurious effects whatever on the system. In regard to the alleged injurious effects caused by the meat of animals poisoned with hellebore, and which had eaten belladonna leaves, the authors have shown that the accounts published in this regard have not been proved and require further tests.

A Curious Experiment in Food Preservation

has lately been tried. It has long been known that the most perishable kinds of food can be preserved for long periods by freezing. In the arctic regions, where the natural temperature favours such a course, freezing is relied on to preserve meat for months at a time. The introduction of artificial freezing processes has caused freezing to be utilised in our own more southern latitudes with greater or less success for the same object. A test of the question of food preservation, by the above means, was recently brought to a striking conclusion. A few weeks ago, a dinner with a remarkable *menu* was given in New York. The primal object of the gathering was to test the palatability of a turkey, which had been killed ten years ago, and which had been kept frozen ever since. One of the guests had been the custodian of the bird during all those years. The turkey was prepared as a part of the dinner.

The Fowl was Perfect in Shape,

and without taint of any sort, but its meat was utterly tasteless and void of all the flavour and juices proper to a well-roasted turkey. The fat and juices had entirely disappeared, leaving only bone and muscular fibre. The prevailing impression as to the inferiority of frozen food products was fully borne out by this interesting experiment. It is known that freezing impairs the flavour of meats, fish, and vegetables, and while it arrests decomposition it does not entirely prevent evaporation and desiccation. Housekeepers who are particular about providing the best beef, fowls, and provisions in general for their tables, are very apt to avoid the purchase of any products which have been frozen. For reasonable periods food is kept by cold without freezing, and this is virtually the action of our domestic refrigerators. Absolute freezing with preservation through one or two seasons is not to be commended.

An Interesting Railway Experiment

is about to be tried in the north of France, the result of which will be watched with interest. All carriages, even on short distance trains, are to be warmed by means of boxes of acetate of soda. The chemical is put into boxes in a solid state and then plunged into hot water, the effect being that the soda is made liquid. The boxes are then wiped dry and put into the carriages, and as the soda gradually solidifies —an operation occupying from five to six hours—the heat it has absorbed in the melting process is given off, and warms the compartment in which it is placed. Should the experiment prove permanently successful, it will be a great

improvement on the present system of foot-warmers, which so rapidly cool, and the idea will be worthy of consideration by English companies.

The Velocity of the Electric Current

is forming the subject of experiments with Philadelphia scientists. An experiment will be made, probably from the Franklin Institute, by connections over the Atlantic cable to Liverpool and return. A recent test appeared to show that an electric current travelled to Europe and back in something like a second, or at the rate of only some 400,000 miles a minute, while light travels 11,178,000 miles. American scientists are not willing to give up the record to sunlight. The most recent experiment was tried at McGill College, Montreal, to Liverpool and return. The distance traversed was 8,000 miles. Time, 1 second and $\frac{1}{20}$ of a second. The conditions were not good. Hence the necessity for another experiment. Some enthusiastic electricians claim that a current will speed around the world in a trifle over 3 seconds, or cover the distance to the sun, 96,000,000 miles, in $3\frac{1}{2}$ minutes.

The Number of Stars Visible at one time

on a clear moonless night by the naked eye, if the person be well situated for observation, is about 2,500. This comprises the number which will be in the field of vision from the northerly to the southerly horizon and from the easterly to the westerly. The stars, of course, which are above the horizon to us in summer are below the horizon in winter, except the stars near the pole, which are in view all the year, but the number which can be discerned by the unaided vision does not greatly differ from one season to another. Some persons will have stronger visual powers than others, but the average individual can at any one time, when conditions are favourable, discern about 2,500 stars and no more.

How to Tell Death

with the greatesty degree of certainty was the subject of a prize of £1,000 awarded by a French scientific society. The *modus operandi* suggested by the winner of the prize was to hold the hand of the supposed corpse against a strong light, when, if life still existed, a pink flush would be noticed where the fingers touched each other. If this sign was absent, death had taken place.

The Most Extensive Telephone System in Europe

in proportion to population is to be found in Sweden. For the further perfection of the service, the General Telephone Company, in Stockholm, now offers to put apparatus in subscribers' houses for eleven shillings per year each. The tariff for each call will be one penny farthing extra. The lowness of the price is the result of competition between the government telephone system and the General Telephone Company.

Too Much Dumb-bell Exercise

is a weariness to the flesh, and matutinal swinging of the Indian club becomes, sooner or later, irksome. The idea of relieving the tedium of daily exercise while increasing its benefits is a good one, and will soon be placed at the service of the public in a practical form. A polished wooden box contains the appliances incidental to the ordinary exercising machine, and is equipped, in addition, with a magneto-electro apparatus capable of transmitting an electric current to ten or more persons at the same time, or being graduated to the endurance or pleasure of one person; so that, while the various forms of exercise are being gone through an electric current of any required strength can be imparted It is claimed that electricity can thus be applied under improved and more pleasant conditions than formerly in many cases where its use has been proved to be most beneficial. Attention is called to the fact that telegraph operators, accountants, typewriters, pianists, and all whose work is apt to cause muscular pains and stiffness in the hand and arm, can, by the use of this exercising machine, reap a two-fold advantage. The machine has a bath attachment. This is placed in a bath, and when the foot is placed upon it an electric shock of graduated strength is imparted to the bather. The machine can be used either with or without the current, and has no battery, and its electric activity is guaranteed for years.

The Invention of Electrocution

might well be claimed by Mr. Edison, for a correspondent, who worked with him when an unknown telegraph operator in Boston, Mass., is responsible for the following story:— One of his pastimes in leisure moments was the slaughter of cockroaches by electricity. He rigged a little arrangement on the wall of the office, which was infested with these vermin, made of two squares of tinfoil from tobacco packages. These squares were pasted on the wall very near together, and between them was daubed some molasses. Each piece of tinfoil was connected with an electric current by a fine copper wire. The cockroaches, attracted by the molasses, would march in procession up the wall, and as they reached the sweet stuff a circuit would be connected between the pieces of tinfoil, the demise being swift and sudden.

Buried Treasures,

so frequently discovered on the sites of ancient cities in Asia and Southern Europe, might suggest the idea that the lap of our Mother Earth must have been the favourite savings bank of the Mediterranean nations: but a more plausible explanation can be found in the barbarous war methods of Pagan antiquity. Not Attila and Tamerlane only, but many leaders of civilised nations, made it a frequent practice to punish the resistance of defiant garrisons by the absolute demolition of hostile cities. The houses, with such hidden valuables as their vaults might contain, were knocked down with battering rams, after the inhabitants, to the last man, had been either slain or marched off in chain gangs.

Palladium,

which is a whiter, lighter, and more fusible metal than platinum, has of recent years been much used to plate watch movements. According to M. Pilet, four milligrammes (about one-seventeenth of a grain) of palladium is sufficient to coat the works of an ordinary sized watch. M. Pilet recommends the following bath: Water, 2 litres; chloride of palladium, 10 grammes; phosphate of ammonia, 100 grammes; phosphate of soda, 500 grammes; benzoic acid, 5 grammes. This bath is suitable for all metals except zinc.

COUPON COMPETITION.

The award in our Coupon Competition will be made in our next issue.

SCIENCE QUERIES AND ANSWERS.

A prize of two shillings and sixpence will be awarded for every interesting question asked by our readers and published in this column and five shillings will be given for every answer published. In all cases when a similar question or reply is sent in by two or more correspondents, the award will be given to the one whose letter is first opened, provided the subject is properly treated. Questions asked by correspondents and not replied to by our readers, may, if of sufficient interest, be dealt with Editorially.

Rules for Competitors.—(1) Only one question may be sent each week, but any number may be answered. (2) Write on one side of the paper only. (3) Envelopes must be marked "Science Queries and Answers," and must arrive not later than the Thursday following date of publication.

These Prizes are intended to take the place of the "Prize Science Sifting," which will accordingly be discontinued.

1.—How fast do waves travel; and what is their greatest height in mid-ocean? I have been told they never exceed 32 feet—the height to which water may be drawn by a pump.

The Atlantic rollers frequently attain a height of 40 feet from trough to crest. They travel, when the length of the wave is, say 300 feet, at the rate of about 40 feet per second, or 27 miles an hour; and the wave movement, that is, the up-and-down motion of the particles of water, is propagated also far below the surface. Thus, at a depth of 300 feet, the "height" of the above-mentioned wave is represented by a disturbance of the water particles about half an inch from their mean position.

2.—When was the sun dial invented?

The art of dialling must have been one of the earliest applications of a knowledge of the apparent motion of the sun. We find the sun dial mentioned in Isaiah xxxviii. 8 (about 700 B.C.)—"I will bring again the shadow of the degrees which is gone down in the sun dial of Ahaz ten degrees backward." The most ancient sun dial, of which a detailed description has been transmitted to us, is that of Berosus, a Chaldean astronomer, who probably lived about 340 B.C. His dial divided the period of daylight into twelve equal parts.

3.—What is the rate at which letters are conveyed by pneumatic tubes? What course is adopted in case one of the letter-carriers should stick in the tube at some unknown point?

A distance of about 1,000 feet is traversed by the carriers in one minute. When a stoppage occurs, as sometimes happens from the presence of foreign matter in the tube, and when increased pressure of air fails to dislodge the impediment, a pistol shot is fired at the mouth of the tube, and the time which elapses before the wave of sound thus projected through the tube is reflected back again to the orifice is noted, preferably with the aid of an electrical recorder. From this interval of time, together with the known velocity of sound, the position of the fault can be exactly determined, and the pipe can then be opened at the proper joint.

4.—Are any flying fishes to be found on our coasts?

Flying fishes are, as a rule, found only in tropical and sub-tropical seas. It may be mentioned, however, that some specimens, such as the flying gurnard (*Cephalacanthus volitans*), are to be seen off European coasts. I may add that it is a mistake to suppose that these fishes can control the direction of their flight in air. It is only when they are wholly or partially submerged in water that their motion can be voluntarily changed. They shoot into the air as projectiles merely, and the path of their flight, except for accidental interference by the wind, is parabolic.

5.—Of what capacity is the largest pumping engine now in use?

Probably the largest pumping station yet constructed is that by which the Ferrara Marshes in Northern Italy are drained. The reclaimed land extends over an area of nearly 200 square miles, and the work done by the pumps consists in raising a little over 2,000 tons per minute, through a height of 7 feet 6 inches, and delivering it into the river Volano at Codigoro.

6.—What is the scientific explanationfof the "tears of strong wine?"

There is a kind of "skin" on the surface of all liquids that is in a state of tension. This surface tension is greater in the case of water than in water mixed with alcohol. A thin film of wine upon the inner surface of a glass loses alcohol, of course, by evaporation, and this takes place most rapidly where furthest removed from the bulk of the liquid, consequently, near the edge of the wine glass, increased surface tension, due to the substitution of a watery for a strongly alcoholic surface, will first make it appearance. Here, then, the surface contracts, and drops are formed. The prominence of this effect depends on the difference in quality of the wine before and after exposure to evaporative influences; and it will be understood that a sure proof of the strength of the liquor is given when it "moveth itself aright."

QUERIES.

7.—Of what are artificial teeth composed?

8.—What quantity of alcoholic liquor, if taken at one time, would be sufficient to cause death?

9.—In what way are blood stains recognised upon clothing?

10.—What constitutes the difference between a plant and an animal?

11.—How much power is concerned in a great boiler explosion?

12.—What is the amount of power contained in a given quantity of steam, and how much of this can be practically utilised?

SIFTINGS OF THE STUDY.

Manipulation of the Microscope.

By Edward Bausch.

(London: W. P. Collins, Great Portland-street.)

Literature on the manipulation of the microscope is very plentiful and very good; nevertheless, Mr. Bausch's little brochure will be welcomed for its several excellent features that must assist the student in obtaining an intelligent knowledge of his instrument. The author has set forth with the idea that the reader is absolutely a beginner in microscopical investigation. He, therefore, takes nothing for granted, as do some of the more technical writers. Everything, from the simplest instruction, is carefully and lucidly explained, and as Mr. Bausch is a manufacturer of microscopes and their accessories, it is needless to say that his instructions are reliable. The book commences with a description of the instrument and its various parts, and concludes with instructions for manipulation and the care of the instrument.

A most useful and instructive almanack and calendar for 1892 has been published by Messrs. George Philip and Son, of 32, Fleet-street. It is called "Child Life," and is issued in connection with the extra number of the kindergarten publication of that name. It is intended to provide teachers with suggestions both for lessons to be prepared and observations to be made. We agree with the publishers that the teacher who wants to give a seasonable lesson will find here some useful hints as to what is really going on in nature.

GLEANINGS OF THE GLOBE.

SEVEN hundred million gallons of mineral oil were exported from the United States during the past fiscal year. Its value was £10,262,690.

THE barbarians of Tierra del Fuego set such value on their dogs, that they kill and devour their old women in time of dearth in order to spare their animals.

IT would take all the Lancashire cotton factories 400 years to spin a thread long enough to reach the nearest star at the present rate of production of about 155,000,000 miles per day.

TO remove a wart, cover the skin around the wart with lard, apply over the surface of the growth one or two drops of strong hydrochloric or nitric acid; then keep the part covered up until the scab separates.

THE first known weather record was kept by Walter Merle for the years 1337 to 1344. A few photographic copies of the original satin manuscript, now in the Bodleian Library, have just been made.

A MEXICAN living in Coahuila claims to have discovered a practical and efficient means of guiding balloons. He will demonstrate the success of his invention, he says, as soon as he can procure the necessary funds.

THE transmission of power by means of compressed air has worked well as far as tried, and capitalists are looking into it for general use in cities, the air to be carried in pipes as steam now is below the street surface.

The "Entomologist's Record and Journal of Variation" for December has reached us. It contains a considerable amount of interesting matter, including "Notes on Collecting" and the reports of the entomological societies.

ACCORDING to a German biologist the two sides of the face are never alike. In two out of five the eyes are out of line; one eye is stronger than the other in seven persons out of ten, and the right ear is generally higher than the left.

DURING last winter the earth of the village of Kirnujarwi, near Paja, Lapland, became suddenly very hot, the ice and snow melting immediately, and the application of one's hand to the earth was liable to result in an uncomfortably warm sensation.

AN electric letter stamper is at present being tried at the Post Office in Washington, U.S.A., in which the time-stamp is altered every minute. The time-stamp on those at present in use is only altered each hour, or at the most each half-hour.

THE reason why grass becomes rank when allowed to grow unchecked after having been long mown, is because the more vigorous plants gradually kill the less vigorous, although fully grown plants. This is an illustration of what Herbert Spencer describes as the "survival of the fittest."

THE French manufacture a paper linen so cleverly that it is almost impossible, without examination, to detect the difference between it and damask. And even to the touch the articles made of paper linge are much like linen, and are used for many purposes for which linen is applicable.

THE pear, although cultivated in classical times, appears, from Pliny's description, to have been a fruit of very inferior quality. The ancients never thought what splendid fruit we should eat, although, according to Darwin, we owe this excellence to the modern gardener's knowledge of the science of "selection."

THE laughing plant of Arabia produces black, bean-like seeds, small doses of which, when dried and powdered, intoxicate like laughing gas. The victim dances, shouts, and laughs like a madman for about an hour, when he becomes exhausted and falls asleep, to awake after several hours with no recollection of his wild antics.

AMERICANS use an alloy of one-tenth copper in making coins—to harden them. In England we use less—one-twelfth. Some time ago the Government filled two spinning cylinders, one with English coin and one with American, and set them both revolving. The former wore away much more under the shaking than the American did.

THE Hamilton Gas Works, Canada, claims to have invented a process by which every pound of carbon in a ton of coal can be directly converted into gas, leaving nothing behind but useless slag. The new invention is said to be simple and easy of application. Hitherto only about 17 per cent. of the carbon used could be made to yield gas.

A PNEUMATIC chisel has been introduced into a stone-cutting establishment in Germany. It resembles in appearance a syringe, which the operator holds with both hands, and as he lets it slide over the surface of the stone or metal the chisel chips off splinters and particles. Compressed air, acting on a piston, imparts a rotation of from 10,000 to 12,000 revolutions per minute.

THE discovery of an enormous underground reservoir of water in the midst of the Sahara Desert will undoubtedly develop trade and travel throughout that region. Explorations have shown that there are large portions of the Sahara which are really capable of cultivation, and after a time it will doubtless be as completely effaced from the map as has been the Great American Desert.

A NEW machine for taking the contour of a country in a short time is in course of construction. It is a bicycle which, simply wheeled on the ground, and which, as it rises over a hill or descends into a hollow, traces the curve of the surface on a sheet of paper by means of an adjusted pencil. The theory of the machine is too mathematical to enter into; but engineers in trying climates will be glad to avail themselves of an instrument so convenient.

PROF. ELIHU THOMSON finds in his experiments on the physiological effects of alternate currents that the danger of the current diminishes as the number of alternations per second is increased. Thus, it took twenty times as strong a current to kill a dog when the alternations were 4,500 per second than when they were 120 per second. When the alternations were 300 per second, the current was only half as dangerous to life as when the alternations were 120.

EXPERIENCES WITH HYPNOTISM.

As one of the earliest among English physicians to study the Nancy method of treatment by hypnotism, a medical man feels it his duty to speak very plainly of the dangers attending the ignorant and injudicious use of this powerful agent. He is the more impelled to do so, because the cause of medical hypnotism has suffered through the confusion existing in the popular mind between it and the hypnotism of shows and entertainments. When people assert that hypnotism is essentially dangerous, and that its employment should be made illegal, it is as well to inquire what variety of hypnotism is referred to. If the speaker has in mind either amateur experiments or public performances, any hearer who has studied the subject must heartily indorse what he has said; but if, as is sometimes the case, no discrimination is used, and therapeutic hypnotism shares the general condemnation, we should ask, in the first place, whether it has been proved a dangerous agent in the hands of experienced medical men, and, in the second, whether its benefits are such as to justify the incurring of any risk.

In the hands of a conscientious and experienced physician the use of hypnotism is, we believe, absolutely devoid of danger. Last year a circular addressed to the chief exponents of the treatment on the Continent, in America, and in Great Britain and Ireland, asking them for their opinion on this subject, brought forth the reply that they had never met with untoward results, and that they could not conceive the possibility of such results if proper care and judgment were used. The venerable pioneer of suggestive hypnotism, Dr. Liebeault, who has practised for over thirty years among the poor of Nancy, gives the result of his experience in an extremely candid and interesting paper. In this he tells of two or three slight contretemps which happened to him in his early days of inexperience, but he goes on to say that he has never seen any serious accident occur through the use of hypnotism, and records his conviction that harm can result only through faulty method, or ignorance on the part of the operator. The fact that Dr. Liebeault has practised hypnotism so long in a comparatively small town, and that Prof. Bernheim has, during the last five years, hypnotised a large proportion of the patients who have passed through the Nancy General Hospital without having any evil results to register, is a strong proof of the safety of this treatment. But even though hypnotism were proved to be attended by a certain amount of risk, we should hardly be justified in altogether prohibiting or abstaining from its use, if at the same time we could show that its advantages exceeded its drawbacks and that it enabled us to treat successfully some diseases and conditions which resist other measures.

Among such intractable diseases, alcoholism takes a foremost place. The value of hypnotism in treating this malady may be better understood by the reader if reference be made to one or two examples drawn from experience. One interesting case was that of a successful and prosperous merchant, a member of a neurotic and alcoholised family. He had been addicted to alcohol for about three years, but drank only at intervals, between which he entirely abstained from stimulants and worked steadily at his business. When the alcoholic mania seized him he would surreptitiously leave his wife and family, and go into a mean lodging, where he could drink night and day without hindrance. His family would spend days in seeking him, and he would generally be found sleeping off the effects of a debauch. As time went on the attacks became more frequent, and between the last two only a fortnight had elapsed. He was placed under supervision and treated daily by hypnotic suggestion for about three weeks, but he was only slightly influenced by hypnotism, and always retained full consciousness. He returned home, and had no relapse for seven months, throughout which time he worked hard and regularly. In the summer of 1889 he travelled in Scotland on business, and during this journey the double shock of a thorough wetting and some bad news from home had such an effect on him that he took to whisky. He drank heavily for one day, but he was able to pull up of his own accord, and during the following week he called on the hypnotist to have the anti-alcoholic suggestions repeated. Since then he has continued absolutely sober, and that without any further treatment. To show the immense power wielded by hypnotism, we shall quote the case of the manager of an important company, who was on the point of being dismissed from his post. This gentleman was very susceptible to hypnotism; he fell at once into a profound sleep, and proved one of the best of subjects. As he belonged to an alcoholised family, it was necessary to forbid him all use of stimulants; therefore he was told while in the hypnotic state, that alcohol was poison to him, and that the taste of it would in future make him violently ill. To test the efficacy of this suggestion, a small glass of beer was given to him during the hypnotic sleep, and another about half an hour after his awaking; on both occasions the dose instantly brought on an attack of sickness, though the patient had no consciousness of the suggestions he had received. He returned to his home and business after about two months, and has had no relapse. A few weeks ago he was attacked by pleurisy. The attack came on suddenly while he was attending a cricket match, and as he complained of violent pain and faintness, a well-meaning friend made him take the usual rough-and-ready remedy—a glass of whisky. He had hardly swallowed the spirit when he again rejected it, thus affording a proof of the continued action of suggestion after the lapse of three months and under altogether exceptional circumstances.

Alcoholism is by no means the only disease originating in bad habits and want of self-control. Morphinism, for example, and the "tobacco habit," have also their victims, and the suggestive treatment which has been found useful in alcoholism has also proved efficacious against those kindred evils.

DANGERS OF ELECTRICITY.

In a paper recently read before the Franklin Institute, Mr. W. McDevitt, Inspector of the Philadelphia Board of Fire Underwriters, dwelt upon certain dangers connected with the electric illumination of buildings. Some of these are due to defective fittings, and the most important is that relating to fusible connections. These are made of a great variety of alloys, some having good electrical conductivity and being slow to heat, while others exhibit weakness when heated and are continually breaking, an accident which tempts a workman to patch up the joints with ordinary wire instead of the proper fuses. Another danger is indicated in the want of some effective method of making splices or joints in conductors, it being a common practice to merely solder such joints, when in case of accident the solder may melt, leaving a loose connection. But the most alarming risk is from the possibility of lightning entering a house where the electrical supply is from aerial conductors, especially where the wires are attached to gas fittings. In this case the electricity in leaping from the charged wires to the gas-pipes will melt the latter, and ast eady blaze of gas from the injured pipe will result.

THE DIFFERENCE BETWEEN MAN AND WOMAN.

There has been of late years considerable discussion in regard to the brain weight and mental capacity of men and women. The following points may be considered established :—

The brain of the child is larger in proportion to its body than is that of the adult, but immaturity should prevent too many studies being undertaken in youth.

The skull of the human male is of greater capacity than that of the female, and civilisation increases the difference. The average male brain weighs a little over forty-nine ounces, the female a little over forty-four ounces, or about five ounces less. The proportion being 100 to 90.

Relatively to the weight of the body the difference is in favour of women. The body of the female is shorter and weighs less than that of the male. Thus in man the weight of the brain to that of the body averages as 1:36·5, while in women it is as 1:36·46, a difference of ·04 in her favour.

A large brain may have its grey cortical substance thinner than a smaller brain.

In man the frontal lobe, separated from the posterior portion by the "fissure of Rolando," affords 43·9 per cent. of the total brain length in the male, 31·3 per cent. in the female.

The specific gravity is greater in male than female brains, but this increases in insanity and old age in both sexes.

Romanes alleges for women a comparative absence of originality, particularly in the higher levels of intellectual work, but there is no disparity in the powers of acquisition after adolescence, young girls being more acquisitive than boys of the same age. After development, the male has the greater power of amassing knowledge. Woman's information is less wide and deep and thorough than that of a man. In musical execution he concedes equality. The female lacks judgment and impartiality, but is more refined in her sense faculties; her perceptions are more rapid, thoughts swifter but superficial. Her will control is less, her temper unstable, and emotions shallow. Coyness, caprice, vanity, love of display, and admiration for pageants, society, and even "scenes," characterise her. Romanes concurs with Lecky: "In the courage of endurance females are superior, but their passive courage is not so much fortitude which bears and defies, as resignation which bears and bends. They rarely love truth, though they adore what they call 'the truth,' or opinions derived from others, and hate vehemently those who differ from them. Their thinking is a mode of feeling; they are generous, but not in opinion. They persuade rather than convince, and value belief as a source of consolation rather than as a faithful expression of the reality of things."

Romanes attributes all this to their not having enjoyed the same educational advantages as men, and accords women preëminence in affection, sympathy, devotion, self-denial, modesty, long-suffering, reverence, religious feeling and morality. Feminine taste is good in small matters, but untrustworthy where intellectual judgment is required. He attributes much to the coarser nature of man suppressing female chances for equity, and holds that the coyness, caprice, and allied weaknesses and petty deceits are acquired and inherited traits of self-defence, intensified by natural sexual selection.

Some important matters that were wholly neglected, or but merely hinted at in the discussions referred to, may be indicated here.

The processes of development known as embryology alone settle the matter of sex differentiation, and proclaim woman to be a very highly organised being—exquisitely adjusted to an important life relation, that dominates her intellectually as well as physically, affording her the advantage of mental refinements and the disadvantage of physical inferiority. In the offspring there is a fusion of advantageous traits that at first belong to both sexes unequally; acquired beauties of form and character that sexual selection perpetuates and perfects. The mental and physical superiority of the average male needs the amiable governance of the female disposition. This is most apparent in mining countries where males preponderate and unconsciously grow coarse in their manners and ways of thinking.

The microscope has transferred the conception of degrees of intelligence from gross to finer morphology. Mere brain weight counts for nothing, except for the crudest generalisations. Of more consequence are the relative quantities of white and grey matter in brains, the associating nerve bundles that pass in showers of minute telegraph lines between brain parts, and of equal, if not transcendent, importance, the disposition and development of the blood vessels. Also, given two brains exactly alike, a difference in the heart's ability to supply blood to the brain will determine stupidity in one and intellect in the other. Intelligence depends more upon the quantities relating fibres of parts of the brain than upon weights, and a forty-ounce brain may have a more intricate microscopic development than one that weighs fifty ounces.

The normal brain exists in ratios related to muscular development, and the brain-weighing methods fully demonstrate that woman is the equal of man in this particular, that is, in proportion to physical development there is no difference in the associated brain quantity in the sexes.

New avenues are opening up to women and decades change our veiws concerning women's capacities. Let there be the fullest chance for her development. She cannot surpass in certain matters, but let opportunity and not *a priori* prejudice settle what she can and cannot do. It is idle to fear that she will become the intellectual and physical monster of Bulwer's "Coming Race." There are physiological reasons that set limits for both sexes.

The subject is exhaustless, and we reluctantly leave much that we wished to dilate upon unsaid. Tennyson's verse appropriately helps our closing :

> The woman's cause is man's! they rise or sink
> Together, dwarfed or Godlike, bond or free.
>
> * * * * * *
>
> For woman is not undeveloped man,
> But diverse: could we make her as the man,
> Sweet Love were slain: his dearest bond is this,
> Not like to like, but like in difference,
> Yet in the long years liker must they grow;
> The man be more of woman, she of man;
> He gain in sweetness and in moral height,
> Nor lose the wrestling thews that throw the world;
> She, mental breadth, nor fail in childward care,
> Nor lose the childlike in the larger mind;
> Till at the last she set herself to man,
> Like perfect music unto noble words.

The science of soap-making has advanced by leaps and bounds of late years, but perhaps the most useful discovery for laundresses, from a time and labour saving point of view, is that known as "Venus Soap." Chemical analysis has proved it to be harmless to the clothes and efficient at its work.

SOME THEORIES ABOUT DEATH.

For the future of physic we require, Dr. B. W. Richardson considers, to revise our views respecting the molecular changes which occur in nervous matter. The discoveries, in electricity, of Galvani and Volta, and the experiments made by Aldini, the distinguished nephew of Galvani, at the commencement of this century, were sufficient to startle every mind, and to develop a new era of thought. In 1803, one John Forster, a malefactor, twenty-six years old, was hanged at Newgate on the 17th of January, a cold frosty day. The malefactor swung in the cold air one hour, with the thermometer 2° below freezing point. Then his body was conveyed to a house near, and, in pursuance of sentence, was delivered to the College of Surgeons. Master Keate, Master of the College (some of us remember Master Keate very well), Carpue (Thomas Hood's own Carpue), Hutchins (one of Carpue's prosectors), Cuthbertson the electrician, Blicke, an anatomist, Dr. Pearson, a physiologist, and young Mr. Brodie, were all at this house, together with Aldini. Aldini had a battery of forty cells in three troughs, and malefactor John Forster, cold, stiff, and stark, was subjected to the influence of the battery. An arc was made from the ear to the lower part of the trunk, and as the electrical stream flowed and penetrated into the life-suspended muscles, those muscles played again. John Foster grinned horribly at his manipulators as if they were hurting him; he opened one eye, and fixed it on something; he moved his limbs. They withdrew the electricity, and John Forster was quiet again; they tried if strong ammonia to his nostrils would influence him, and found it would not; but they re-applied the electricity with the ammonia, and the effect was so extraordinary they thought the wretch was actually alive again; but they stopped, and he stopped. Then they opened his chest, and exposed his heart, to find that no electrical current would restore its rhythm; so it was clear that all through the experiment John Forster had not lived by his heart. It is also clear that voluntary muscles may be irritable, while the involuntary heart is quite dead.

The experiment, as well it might be, was the marvel of the world, and Aldini, who did not, he tells us, mean to bring the malefactor back to life, became the hero of the hour. He was "presented." Master Keate made a good stride toward Court eminence, and altogether there was popular fame on the winds travelling briskly over John Forster, malefactor in 1803. As to the world of science, it was wild with commotion; a volcano bursting through a tranquil lake was not more grandly disturbing. Other experimentalists performed the same experiments on dead malefactors, and with like results; Galvani's theory of animal electricity recovered from the attacks of Volta; and by a vast leap of learned speculation, the human body was declared to be an electrical machine. Of course, for is not the torpedo such a machine, and is not that proof direct? So at once the old researches, from the time of Sylvius, through Haller, Winslow, the Munroes, about the existenec of a veritable nervous fluid, went to the wall without question, or were as ignored as if they had never been.

Galvani's and Aldini's experiments were astounding, and rightly read they retain, as do all carefully proved facts, a lasting value; but they led to more error than any of which we know. There is no nonsense in science so gross as the garner of nonsense that has been gathered up to this very time on the so-called animal electricity. Incoherency can go no further that it has gone in this direction, while science has not advanced a minute's mareh in ninety years toward even a preliminary demonstration of the existenee within living bodies, of a sign of an electrical mechanism, except in the rare cases of one or two specially-constructed electrical animals.

Here then, Dr. Richardson writes, in a signed article in the *Asclepiad*, we have to call back and revise. We want to know, even yet, whether there be a nervous fluid traversing the nervous cords, or circulating between the nerve centres and the blood. And, particularly, we want to ascertain what is the molecular change of matter of the nervous system, when it sleeps or rests, when it wakes or moves. Light begins to break on this primary inquiry. We can make nervous substance temporarily solid by cold, *i.e.*, by crystallising it, and then the nervous structure rests and sleeps. We have to see, then, whether, when our eyes droop with natural sleep, this same change of structure is not progressing naturally in nervous structure; we have to ask whether under sudden shock—shock from a bullet, for instance—the complete destruction of nervous power is not due to change of nervous matter under sudden vibration of its particles, like the change which occurs when water suddenly solidifies under motion, or when fluid fat becomes a concrete mass under brisk agitation.

THE SCIENCE OF SINGING.

Personally, says an authority on this important subject, I do not believe in voice building. Nature must give a girl a voice or else she will never acquire one. I often have the question asked if a voice can be made to do this or that. My answer is, that the natural voice can do so much and nothing more. Every singer with a modicum of common sense should know just what his or her voice can do, and not recklessly strain it by attempting to sing in a large hall. Straining a voice means the beginning of the end. One pure, natural note is a joy for ever, but a falsetto note is the ghost of departed sweetness. I can explain what I mean better by making a rather trite but true comparison. If a man has an income of £20 per month, and lives up to it, he never saves anything; but if he only spends £15 a month, he has £5 left. That £5 represents reserved capital. Now, if a singer has a voice of a limited compass and she attempts to go beyond it, or keep up to it, she will inevitably break down; it is the law of compensation and nature. It is far better for a young lady who has a small but sweet voice never to attempt to sing in a large hall. A man knows just how far he can jump, and singers know what their voices can do. Well, now, if a man who knows he can only jump 8 feet tries to jump 12 feet and fails, he can only blame himself. "Oh, but why did he not consult friends or a professional athlete?" some one will ask. That would have done no good, because the man knew what he could do himself. Now, young girls who are taught at home, or even in conservatories, soon find out what strength and compass their voices have, and if they recklessly attempt to go on the stage when they have voices that are inadequate, I do not know how it can be prevented. Voices should be well cultivated. I have heard small voices that were sweet and fresh because they were natural and not strained. A young lady had better, by far, cultivate her voice, if a small one, for parlour singing, and have it natural, than ruin it by straining for a greater compass. She can give her friends at home a treat that would make no impression on an audience in a large concert hall. It is better to have a sweet voice in a room 8 feet by 10 than to have a cracked falsetto voice in a big concert hall.

THE VEXED QUESTION OF ELECTRICITY.

The most vexing thing to the electrical scientist lies in the disagreement as to what electricity really is, irrespective of the results attained by it. We were much criticised by the electrical press because in the first issue of SCIENCE SIFTINGS we asked: "What is Electricity?" and, of course, were unable to reply to our own query. As our technical critics are equally ignorant, their criticisms are not of much account. At the recent dinner of the Institution of Electrical Engineers, Professor Crookes was very hopeful as to what the future might unfold about the question. He congratulated the scientific world on the fact that we have happily outgrown the preposterous notion that research in any department of science is mere waste of time. It is now generally admitted that pure science, irrespective of practical applications, benefits both the investigator himself and greatly enriches the community. "It blesseth him that gives, and him that takes." Between the frog's leg, quivering on Galvani's work table, and the successful telegraph or telephone, there exists a direct filiation. Without the one we could not have the other.

We know, in short, little as yet concerning the mighty agency of electricity. "Substantialists" tell us it is a kind of matter. Others view it, not as matter, but as a form of energy. Others, again, reject both these views. Professor Lodge considers it "a form, or rather a mode of manifestation, of the ether." Professor Nikola Tesla demurs to the view of Professor Lodge, but thinks that "nothing stands in the way of our calling electricity ether associated with matter, or bound ether." High authorities cannot even yet agree whether we have one electricity or two opposite electricities. The only way to tackle the difficulty is to persevere in experiment and observation. If we never learn what electricity is, if, like life or like matter, it should remain an unknown quantity, we shall assuredly discover more about its attributes and its functions.

The light which the study of electricity throws upon a variety of chemical phenomena — witnessed alike in our little laboratories and in the vast laboratories of the earth and the sun — cannot be overlooked. The old electro-chemical theory of Berzelius is superseded, and a new and wider theory is opening out. The facts of electrolysis are by no means either completely detected or co-ordinated. They point to the great probability that electricity is atomic, that an electrical atom is as definite a quantity as a chemical atom. The electrical attraction between two chemical atoms, being a trillion times greater than gravitational attraction, is probably the force with which chemistry is most deeply concerned.

It has been computed that, in a single cubic foot of the ether which fills all space, there are locked up 10,000 foot tons of energy which have hitherto escaped notice. To unlock this boundless store and subdue it to the service of man is a task which awaits the electrician of the future. The latest researches give well-founded hopes that this vast storehouse of power is not hopelessly inaccessible. Up to the present time we have been acquainted with only a very narrow range of ethereal vibrations, from extreme red on the one side to ultra-violet on the other—say from 3 ten-millionth's of a millimetre to 8 ten-millionths of a millimetre. Within this comparatively limited range of ethereal vibrations, and the equally narrow range of sound vibrations, we have been hitherto limited to receive and communicate all the knowledge which we share with other rational beings. Whether vibrations of the ether, slower than those which affect us as light, may not be constantly at work around us, we have until lately never seriously inquired. But the researches of Lodge in England, and Hertz in Germany, give us an almost infinite range of ethereal vibrations or electrical rays, from wave lengths of thousands of miles down to a few feet. Here is unfolded to us a new and astonishing universe — one which it is hard to conceive should be powerless to transmit and impart intelligence.

Experimentalists are reducing the wave lengths of the electrical rays. With every diminution in size of the apparatus the wave lengths get shorter, and could we construct Leyden jars of molecular dimensions the rays might fall within the narrow limits of visibility. We do not yet know how the molecule could be got to act as a Leyden jar, yet it is not improbable that the discontinuous phosphorescent light emitted from certain of the rare earths, when excited by a high tension current in a high vacuum, is really an artificial production of these electrical rays, sufficiently short to affect our organs of sight. If such a light could be produced more easily and more regularly, it would be far more economical than light from a flame or from the arc, as very little of the energy in play is expended in the form of heat rays. Of such production of light, nature supplies us with examples in the glow worm and the fireflies. Their light, though sufficiently energetic to be seen at a considerable distance, is accompanied by no liberation of heat capable of detection by our most delicate instruments.

By means of currents alternating with very high frequency, Professor Nikola Tesla has succeeded in passing by induction through the glass of a lamp, energy sufficient to keep a filament in a state of incandescence without the use of connecting wires. He has even lighted a room by producing in it such a condition that an illuminating appliance may be placed anywhere and lighted without being electrically connected with anything. He has produced the required condition by creating in the room a powerful electrostatic field alternating very rapidly. He suspends two sheets of metal, each connected with one of the terminals of the coil. If an exhausted tube is carried anywhere between these sheets, or placed anywhere, it remains always luminous.

The extent to which this method of illumination may be practically available, experiments alone can decide. In any case, our insight into the possibilities of static electricity has been extended, and the ordinary electric machine will cease to be regarded as a mere toy.

Alternating currents have, at the best, a rather doubtful reputation, but it follows from Tesla's researches that as the rapidity of the alternation increases they become not more dangerous, but less so. It further appears that a true flame can now be produced without chemical aid—a flame which yields light and heat without the consumption of material and without any chemical process. To this end we require improved methods for producing excessively frequent alternations and enormous potentials. Shall we be able to obtain these by tapping the ether? If so, we may view the prospective exhaustion of our coal fields with indifference. We shall at once solve the smoke question, and thus dissolve all possible coal rings.

Electricity seems destined to annex the whole field, not merely of optics, but probably also of thermotics.

Rays of light will not pass through a wall, nor, as we know only too well, through a dense fog. But electrical rays of a foot or two wave length, of which we have spoken will easily pierce such mediums, which for them will be transparent.

Professor Crookes speaks of another tempting field for research, scarcely yet attacked by pioneers, awaiting exploration. He alludes to the mutual action of electricity and

life. No sound man of science indorses the assertion that "electricity is life"; nor can we even venture to speak of life as one of the varieties or manifestations of energy. Nevertheless, electricity has an important influence upon vital phenomena, and is in turn set in action by the living being—animal or vegetable. We have electric fishes—one of them the prototype of the torpedo of modern warfare. There is the electric slug, which used to be met with in gardens and roads about Hornsey-rise; there is also an electric centipede. In the study of such facts, and such relations, the scientific electrician has before him an almost infinite field of inquiry.

The slower vibrations to which Professor Crookes has referred reveal the bewildering possibility of telegraphy without wires, posts, cables, or any of our present costly appliances. It is vain to attempt to picture the marvels of the future. Progress, as Dean Swift observed, may be too fast for endurance. Sufficient for this generation are the wonders thereof.

AMMONIA AND SUICIDES.

Of the number of those seeking suicide by swallowing some form of poison, probably there are few who have sought to kill themselves by means of ammonia. Nevertheless, ammonia, although it is the active agent in most of the salts sold to women for their gilt decorated and perfumed scent bottles, is poisonous when taken internally in a concentrated form. There have been recently several cases where death took place in a comparatively short time after the ammonia was taken.

There are on record, also, cases of slow poisoning from ammonia administered with intent to commit murder. Furthermore, the appearance of workmen in guano factories where ammonia is set free by grinding guano, has been noted, and in every case there is an unmistakable system of poisoning. This is discolouration of the skin of the face, which assumes a blotched, dirty appearance. First to take on this appearance is the skin of the nose and forehead. Autopsies of those who die from ammonia reveal a dark hue on the mucous membrane lining the stomach and intestines.

As an agent for causing death by slow poisoning, ammonia is one of the most certain and most difficult of detection, owing to its volatile nature. This quality has led physicians to believe that some of the mysterious deaths that have taken place in the history of modern and mediæval crime are due to ammonia. It is known now that months have elapsed between the first symptoms of sickness and the death of a person from ammonia poisoning. On the other hand, death has resulted in four minutes from the time a large draught of ammonia has been swallowed. It has been found in cases of gradual absorption of ammonia in the human system, that there is a general elimination of healthy oxidation of the blood, and a constant lowering of the bodily strength. In the cases of immediate poisoning, death comes with frightful agony. Blood gushes from the nose and mouth.

Statistics in England put ammonia thirteenth in frequency in the list of poisons. Dr. Alexander Winter Blyth, cites thirty cases of poisoning by ammonia, swallowed for the purpose of committing suicide, or administered with the purpose of committing murder, *or absorbed unconsciously in food.* Of the suicidal cases six were fatal. Of twenty accidental cases twelve were fatal. Of cases of murder with ammonia, Dr. Blyth notes two, both of them children.

ANIMAL ADVANCE.

If the conceptual world of the lower animals is limited and fragmentary, so is that of savages and of ignorant and uncultivated men, who live for the most part in the present and the immediate past, and have a relatively narrow range of thoughts and experiences. Long-lived animals, such as parrots, ravens, and elephants, have an advantage over short-lived animals in the development of intelligence. Civilised man, however, not only lives his own individual life, and profits, like other animals, from the wisdom of his parents and the influences of his environment, but also, by means of written records, lives the life of the race, of which he enjoys the most select fruits garnered in history.

Every dog trained as a hunter or herder is a specialist, and is prized for one fine capacity attained in some degree at the expense of mental proportion and symmetry; in miscellaneous matters outside of his province he may be easily surpassed by any underbred and mongrel, but many-sided, village cur. Modern scholarship shows a like tendency to psychical alogotrophy or one-sided intellectual growth. As science deepens its researches, each department of investigation becomes more distinct, and the toiler in the mines of knowledge is forced to confine his labours to a single lode if he would exhaust the treasures it contains. He sees clearly so far as the lantern casts its rays; but all outside of this small luminous circle is dense darkness.

If a race of superior beings had taken charge of man's education for thousands of years and conducted it on the same principle as that which has guided us in domesticating and utilising the lower animals, what maimed specimens of humanity would have been the result! Slavery has always tended to produce this effect; but the slave, however degraded his condition, speaks the same language as his master, thereby profiting from his intercourse with those who are placed over him, and sharing in the general progress of society more fully than any dumb animal could do. So, too, the position which Christian intolerance assigned to the Jews for many centuries, closing to them all branches of industry except usury, developed in them a peculiar talent for finance, together with many hard and offensive traits of character naturally growing out of money brokerage, and finally becoming almost innate. In the middle ages they were made to serve as sponges to suck up the people's substance in order that it might be squeezed out of them at the convenience of the rulers. King John II., surnamed the Good, issued in 1360 a decree permitting the Jews in his realm to take, as compensation for lending money, "quatre deniers par livre par semaine," equivalent to ninety per cent. per annum, not from any feeling of favouritism for the Israelites, but, as he expressly stated, because, "the greater the privileges enjoyed by the Jews, the better they will be able to pay the taxes levied on them by the king." This "good" monarch was wont to confiscate periodically a large portion of the pillage thus obtained in order to replenish his exhausted exchequer, and was actually praised by his subjects for punishing Jewish rapacity.

In the early part of the thirteenth century, Frederic II., the Hohenstaufen, ordained that the Jews should be permitted to dwell in Nuremberg and to lend money on interest, stating that, "inasmuch as this sinful business is essential to trade and to the commercial prosperity of the city, it would be a lesser evil to let the Jews carry it on than that Christians should imperil the salvation of their souls by such practices, since the former, owing to their notorious obduracy, will doubtless persist in their religious perversity and be damned anyhow." If the Jews now

"take a breed of barren metal" as naturally as a pointer takes to pointing, or a hound to the trail of a fox, this tendency is due in part, at least, to circumstances which they did not create and could not control. The chief accusation brought against them by anti-Semitic agitators is that they are unwilling to follow industrial or agricultural pursuits, in utter forgetfulness of the fact that until a comparatively recent date they were forbidden by Christian legislation either to engage in mechanical employments or to own land.

The influence of domestication on the mental development of animals depends upon the purposes which the domesticator has in view. If he regards them merely as forms of food, and his sole aim is to increase the amount of their adipose tissue and edible substance, and thus get the maximum of meat out of them, then domestication tends to stupify them. The intellectual training of the pig would naturally diminish the quantity of lard it would produce. So far as man is concerned, this latter function is the chief end of the porker's existence, and it must not be *tried* and found wanting in this respect, whatever may be its mental deficiencies. It must be fat-bodied whether it be fat-witted or not, and the natural qualities which do not contribute to its gross weight and enhance its ultimate value as victuals are systematically discouraged and depressed.

In view of the treatment that the pig has received for centuries at the hands of man, it is remarkable that the animal has retained so much of its original cunning and love of cleanliness as it now possesses. That a creature so fond of bathing in pure running water should be condemned to a filthy sty is an act of unconscious cruelty discreditable to human discernment. If the sow that has been washed returns to her wallowing in the mire, it is as a last resort in hot weather; she would much prefer a clear pond or limpid stream if she could get access to it. Being fed and protected by its owner in its domestic state, the hog no longer needs to exercise the faculties which were essential to the self-preservation of its wild progenitors. The stimulus arising from the struggle for existence ceases, and, as it is reared solely to be eaten, its association with man does not call forth any new powers. In China and Polynesia, where the dog is esteemed chiefly for food, it is a sluggish and stupid beast. On the other hand, the pig can be trained to hunt, and not only acquires great fondness for the sport, but also shows extraordinary sagacity in the pursuit of game. It has an uncommonly keen scent, and can be taught better than the pointer. Curiously enough, when the pig is used for hunting purposes, the dogs, usually so eager for the chase, sullenly retire from the field, and refuse to associate with their bristly competitor in venery. Possibly the hereditary and ineradicable enmity between the dog and hog as domestic animals may be a survival of the fierce antipathy which is known to exist between the wolf and the wild boar. In Burmah the ringed snake is trained for the chase, and is especially serviceable in flushing jungle-cock, since the reptile can penetrate the thickest underbrush, where it would be impossible for a dog or a falcon to go.

The tamability of an animal is simply its capability of adapting itself to new relations in life, and depends partly on its mental endowments, but still more upon its moral character. It is quite as much a matter of temperament and social disposition as of quickness of understanding. The elephant, dog, and horse among quadrupeds, the beaver among rodents, and the daw and raven among birds, are, for this reason, most easily tamed, and show the most marked and rapid improvement in consequence of their daily intercourse with man. Intellectual acuteness without the social affections and kindred moral qualities rather resists than facilitates domestication. Of all domestic animals the cat was the most difficult to tame, and it needed the patience and persistence so strongly characteristic of the ancient Egyptians, sustained by religious superstition, in order to accomplish this result. Even now the cat, although extremely fond of its home and capable of considerable attachment to persons, has never been reduced to strict servitude and become the valet of man like the dog, but has always remained, to a certain degree, what it originally was, a prowling beast of prey.

Barking in dogs is a habit due to domestication. The wild dog never barks, but only howls, like the Himalayan buansu, or merely whines, like the East Indian colsum; and the domestic dog reverts from barking to howling when it relapses into its primitive state. Wagging the tail is another mode of expression which the dog has acquired through association with man. It is well known, too, that a dog which has been reared by a cat adopts many of the habits of its foster-mother, such as cleaning itself with its paw; by continuously pairing such dogs and rearing them under like influences, it would be possible to produce a canine species with feline traits, which should become permanent and transmissible.

The chief difficulty attending the investigation of mental processes in animals is that they cannot express themselves in human language, and explain to us their thoughts and feelings, and the motives underlying their conduct. We are thus liable to misinterpret their actions and deny them many endowments which they really possess, just as the first explorers of new countries fail to discover in savages ideas and conceptions which are afterwards found to characterise them in a remarkable degree.

We have happily rid ourselves somewhat of the prepossessions which led the Greeks, and still lead the Chinese, to regard all other peoples as outside barbarians; but our perceptions are still obscured by egotistical prejudice which prevents us from fully appreciating the intelligence of the lower animals, and recognising any psychical analogy between these humble kinsmen and our exalted selves.

(*Conclusion. Commenced last week.*)

DENSER THAN THE DEAD SEA.

A wonderful lake named Alia Paal has been discovered on the Hawaii Islands. The waters are more salt than those of the Dead Sea. Samples of the water have been analysed, with results of peculiar as well as scientific interest. The water, which in dry weather deposits salt abundantly, is, of course, saturated brine, yet differs essentially from the brine obtained by evaporation to saturation of ordinary sea water. The difference is strikingly shown by merely mixing the two clear fluids, when a copious deposit immediately forms of sulphurate of lime, so that the mixture almost solidifies. The sea water contains sulphate of magnesia in abundance, but scarcely any lime, while the salt lake waters contain chloride of calcium, lime salt, with only a trace of sulphate.

In composition the water of Alia approaches closely to that of the Dead Sea. The specific gravity of the water, even at a temperature of eighty degrees Farenheit, is 1·256; at standard temperature it would, of course, be higher. The water of the Dead Sea is considerably lighter, its specific gravity having been found by different observers to range from 1·13 (Eynch) to 1·2400 (Lavoisier). The most remarkable peculiarity of the water is the excessive quantity of the lime it carries. This should give it peculiar medical virtues.

THE INHABITANTS OF OTHER PLANETS.

The first thing which most attracts our attention about other planets is their very great difference in size, and this circumstance is the cause of some of their most striking physical peculiarities. Take, for instance, the little planet Ceres. Our earth is small enough, only 7,912 miles in diameter, but Ceres is only 160 miles. These words may easily pass in at one ear and out at the other without leaving any impression behind; or, if they cause us to think, we will wonder how easy it must be to get from one country to another, how delightful to be able to sail round the world, pay a visit to one's friends at the antipodes, and be settled at home again—all within the short space of two successive play days. But if we look at the subject a little more closely, we shall find that it involves far more extraordinary consequences than these. We know that while the earth spins round men, dogs, and horses, balls and stones hold on, or fall to the earth. This force which attracts matter to matter is called gravity, or weight. It is stronger in proportion to the amount of matter, and weaker in proportion to the square of the distance of an object from the centre of gravity. Now, the diameter of the earth being fifty times greater than that of Ceres, it follows that a boy here is fifty times heavier than he would be on the little planet. If he weighs 100 pounds here, he would weigh only two pounds there. Boys could play at ring-taw with huge round boulders instead of marbles, and play football with balloons. Girls could carry dolls as heavy as their mothers, and a strong bull would be an easy load to bear. But things stranger still would happen. We know that if a body be once set in motion it will continue moving for ever, if not stopped by some external force. Thus, when a boy leaps into the air, he would go the moon and further, were it not for the attraction of the earth, which very soon pulls him down. But on the little planet Ceres, this force is so small, that a boy might leap to an enormous height before the attraction would check his ascent. Jumping over a house-top would be as easy as playing leap-frog, while a good jumper would think nothing of clearing, with a short run, the dome of St. Paul's. Staircases might be abolished, for even a stout old lady could easily jump in at a third-story window. The range of projectiles would be increased in proportion. Baby could hurl his rattle pretty well into the middle of the Channel, and in the event of war with France we could probably throw explosives into Paris from Dover. Nor have we yet exhausted the wonders of Ceres.

We can imagine how uncomfortable it must be for a fat man of 300 pounds' weight to walk, run, or exert himself. But transport him to our queer little friend Ceres, and he is at once at ease. In a moment he becomes fifty times lighter than he was—as light, in fact, as a kitten; and he may proceed, if he pleases, to astonish the acrobatic natives of the planet by gymnastic exploits far surpassing even their own. Muscular exertion there goes fifty times as far as it does here; and the exploits men are capable of achieving there must surpass the wildest flights of fancy and the most exaggerated visions of fairyland. Stronger than the vanquished Titans of old, fetters of iron would be to them as threads of gossamer. Like the genius of the Arabian Nights, they could spring from the earth to the clouds at a bound, or clear half-a-dozen miles at a single leap. The seven-league boots would be no longer a fable. A boy could start on a run around the world and be back again before his mother had finished singing out his name; a race-horse could gallop 5,000 miles an hour, while the sea would boil and foam with the gambols of its mighty inmates, and the gigantic carcass of a leviathan extend for a mile along the deep.

If we reverse the circumstances and go to a planet larger than our own instead of smaller, the case will, of course, be exactly the opposite. If we were transferred to the sun, we would feel as much out of our element as the inhabitants of Ceres would feel here on earth; and, in fact, it will be readily seen that if the sun is peopled with beings constituted like ourselves, its population must, owing to increased weight, consist of dwarfs two or three inches in height. Among them Tom Thumb would be a towering giant in comparison. It is very singular that the larger the world the smaller the denizens must be, that the inhabitants of the modest planet, earth, should be men; those of the huge sun, dwarfs; and those of the tiny asteroid, Ceres, giants.

A ZOOLOGICAL CHARWOMAN.

It is pleasant to be assured by naturalists that all the little torments we are familiar with in the insect world are of the greatest importance to man. Naturalists tell us we must endure with philosophy the bites of mosquitoes, while we reflect that mosquitoes render stagnant water pure, and so prevent much disease. Spiders eat flies, and flies, we believe, eat something else more undesirable.

And ants?

Well, an ant is one of the most serviceable insects we can talk about. In the first place, the ant is a great educator. She is proverbial for giving lessons in industry, patience, and helpfulness. We listen to her while she speaks of providing in summer, food for the winter. She means we should lay by a store of knowledge for the days when we shall have need of it. When she drags a beetle through a hole only half the size of her body, she teaches us not to be discouraged if our first attempts do not invariably succeed. And when she helps a sister ant to pull a big crumb of bread over a pebble, we understand her to observe that the smallest of us is not too small to help some one else.

Besides her value as a moral lecturer, the ant is of some substantial benefit as well. In hot countries, where ants most abound and where they are considered the greatest pests by the inhabitants thereof, they make themselves of use by devouring every dead thing—animal or vegetable—which they find. Bird, beast, or insect, plant or tree, it makes no difference to the ants. We are told that in some cases their voracious appetites do not allow them to wait until the unfortunate creatures are dead. They fall upon and devour living ones.

Of their value as scavengers many stories are told. Once a naturalist travelling in Tasmania wished to collect skeletons of snakes. So he killed his snakes and left them on the ground under a hot sun and near an ant hill. And the hot sun and the hungry ants did the work so well that after a few hours he collected his skeletons, cleaned and bleached.

The chasseur ants of the West Indies have a wide reputation as house cleaners. It is not stated whether they carry on their business at regular seasons, but we are informed that when an army of chasseur ants is seen approaching a town, the inhabitants of the town empty all their closets and drawers, leave them open, stand the front door ajar and abandon the house.

Then the ants enter the place "in regular armies and in uncounted millions." Filling the houses from top to bottom they destroy in it every living creature small enough for them to overpower. In these tropical countries many disagreeable small animals and insects infest houses—rats, mice, spiders, and flies, cockroaches, wasps, scorpions and snakes,

and dozens of other creatures. The ants do not leave one of these small things alive to relate the story. They make a clean sweep of everything. And when the ants have eaten whatever is eatable and cleaned every house thoroughly of all impurities, they take up their march for the next town on their list. Then the inhabitants of the cleaned-out town joyously return to their renovated homes. They shut up their closets and drawers with the agreeable reflection that after such a thorough cleaning the house will not want another overhauling for at least a year.

It is to be wondered if these chasseur ants could not be trained to do their house-cleaning when housekeepers want it done, instead of when they feel inclined to do it themselves. If such training were possible the ants might be imported by some enterprising people, and would meet a long-felt want.

BOOK-WORMS.

So seldom is a bookworm to be seen, that when one is captured, it is fairly regarded as a great curiosity. In his charming volume entitled, "The Enemics of Books," Mr. Blades devotes a chapter to this Lilliputian pest, and he speaks intelligently, for he experimented with several live book-worms. One of these worms he kept for a period of eighteen months, an unusually long time for a book-worm to live outside the covers of a book, since, as Mr. Blades truly says, "when freed from restraint (which, indeed, to them is life) they cannot eat, although surrounded with food, for they have no legs to keep them steady, and their natural leverage is wanting."

In a volume of "Hogarth Moralised," there was found a genuine book-worm some days ago. The worm had evidently ended his travels, for he had begun to spin a web about himself, when captured and clapped incontinently into a vial of alcohol. This little fellow is about one-third of an inch in length, and he looks very much like the worm found in apples, peaches, and other fruits. He is tipped with black at both ends, differing in this particular from the book-worms Blades met with. Dr. Bandinel, of the Bodleian Library, told Blades, in 1858, that he frequently found book-worms, and that they sometimes had black heads. Blades, repeating this information, adds: "I never heard of a black-headed book-worm before or since."

Mr. Andrew Lang remarked to the writer, once upon a time, that he had never seen a book-worm, and that he had actually begun to doubt the existence of that pest. The Americans have a lively little silver-coated bug that is frequently met with between the covers of books. This used to be, and still is, regarded by many as the genuine bookworm, but it is in no respect like the Simon-pure; it is what entomologists call the lepisma, and it is comparatively harmless. The book-worm is properly either the anobium or the œcophora; to the former class belongs the tiny depredator recently captured.

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SCIENCE NEWS AND NOTES.

"All that tread the globe are but a handful to the tribes that slumber in its bosom."—WILLIAM CULLEN BRYANT.

Our Science Queries Column

has proved very popular with our readers, and since it was originated many hundreds of interesting and appropriate questions have been received. It will be manifest, however, that space restrictions will only permit us to publish a limited number of these, but those who do not see their questions published at once may do so at a later date. We hope our readers will continue to assist us in maintaining the interest of this column, not only by sending in queries, but also by forwarding answers.

A Strange Death

is reported from New Orleans. It is said that while a hose was being played upon a fire, a telephone wire and an electric light wire got crossed, the stream of water from the nozzle struck the wires, a heavy current followed down the water and killed the fireman who was holding the nozzle.

The Causes of Death

were treated of in the "Prize Science Sifting" column under the heading of "Age," in an early issue. A medical correspondent now writes asking if one of the chief causes of death is not congenital defects, some killing very early, others very late in life. This is undoubtedly the case, and we quite agree with our correspondent that congenital or hereditary defects are responsible for a vast amount of mortality. In fact, the paragraph under discussion said: "The strong are apt to break, or, like the candle, to run; *the weak burn out.*"

Animal Electricity

has been engaging much attention of late, and although we do not put any credence in magnetic ladies and such like phenomena, every scientist must agree that certain animals are gifted with electric powers, or rather the probably unconscious power of generating electricity; or, still more probably, that of collecting it and storing it from sources with which we are so far unacquainted. As we said in our article last week, on the subject of electricity, we have electric fishes—one of them the prototype of the torpedo of modern warfare—the electric slug, and the electric centipede. Prof. McKendrick, in lecturing the other day at the Royal Institution, stated that there were no less than fifty species of animals that were living electric batteries. He related one interesting experiment proving that from whatever source the electricity comes the electric organs were under the control of the fish. A strong current of electricity being sent through a vessel containing some specimens of Gymnotus, the fish at once tried a shock on the unknown foe, but, finding that unavailing, placed themselves in a position in which the current would pass through them sideways—precisely as an electrician would do if he should be similarly situated.

Frictional Experiments on the Cat

have often resulted in a manner shocking to the operator, although not quite in the way anticipated. A sharp-clawed cat is a somewhat awkward thing to handle, and we, therefore, do not counsel our readers to try the following experiment, for the particulars of which we are indebted to a correspondent, Mr. V. Tudor, of 37, Ashmore-road, W. He suggests that the operator "places the left hand upon the throat, and with finger and thumb press slightly the bones of the cat's shoulders; then, if the right hand be gently passed along the back, perceptible shocks of electricity will be felt in the left hand. Shocks may also be obtained by touching the tips of the ears after rubbing the back. Another way of doing it is to place the cat on your knees and apply the right hand to the back as before. Let the left fore paw rest on the palm of your left hand and apply the thumb to the upper side of the paw, so as to extend the claws, bringing by this means your forefinger into contact with the leg. Press it slightly against the bone and you will feel distinctively a successive number of real strong electric shocks." What will the cat be doing meanwhile?

The Artificial Production of Rain

has just been the theme of an excellent paper read before

the electrical section of the Franklin Institute by Prof. Edwin Houston. The professor claimed that the following general conclusions may, in view of the present state of meteorological science, be properly drawn concerning the artificial production of rain :—(1) That rain can never be made to fall at will by mid-air explosions on any part of the earth's surface irrespective of the climatic conditions there existing. (2) That during certain meteorological conditions mid-air explosions may result in rainfall over extended areas. (3) That the liberation of energy necessary for such rainfalls is due not to the mid-air explosions, but to the energy stored up in the moist air from which the rain is derived. (4) That the meteorological conditions which must exist for the successful action of mid-air explosions would probably, in most though not in all cases, themselves result in a natural production of rain. (5) That a comparatively high difference of electric potential between different parts of the air, or between the air and the earth, is possibly favourable when taken in connection with other meteorological conditions for artificial rain making. (6) That an undirected mid-air explosion is not as likely to produce rain as an explosion in which the main tendency of the energy liberated is to cause a general up-rush of the air. We are glad to find the opinions we have so freely expressed in these columns seconded by so excellent an authority. After this, we hope we shall hear no more about the "concussion theory," as it has been called.

This Theory of the Production of Rain

is now as exploded as the dynamite with which it was thought to accomplish it. As we have previously shown, and as Dr. Andrew Wilson points out, it is not the case that cannonading or atmospheric concussion possesses the power and property of breaking clouds, according to the popular belief. The air compression produced by the explosion causes a temporary heating in an atmospheric wave which travels at a rate calculated to be about 1,000 feet per second; but this is all, and such heat and motion cannot have any effect in inducing condensation of the vapour in the air. As regards the lightning flash and the thunder clap which are followed by the rain, these phenomena are to be explained in a contrary way, the rain-drops being the cause and not the effect of the thunder explosion. In Texas the experiments made consisted in the explosion of oxyhydrogen balloons and dynamite. The balloon was exploded by electricity in the air at a height of a mile and a quarter; kites with dynamite attached were sent up thereafter and exploded; while powder charges were also duly let off. Prior to one experiment no appearance of rain was seen, though it is not recorded that the state of the barometer was watched. The result, however, was that heavy rain descended after the explosions, and continued for about four hours and a half. In another case, similar experiments were made with balloons and cannonading at night, the sky being clear. At 11 o'clock the experimenters retired, and at 3 a.m. the rain began, and continued till 8 a.m. This latter account, Dr. Wilson thinks, rather fails to convince one that cannonading stood to the rain as cause to effect. From 10.30 p.m. till 3 a.m. is rather a long interval to have to take into account, considering the perplexity of atmospheric conditions and the liability to sudden meteorological change which undoubtedly exists.

That which Produces Rainfall,

as has been pointed out, is the maintenance of a decided upward motion in the air; and, of course, it may be possible to conceive of rain making as the effect of heated gas or vapour, generated in large amount (as in the Texas experiments) and producing ascending movements in the atmosphere. Only, we have the general state of the atmosphere to reckon with, and, failing what one may call a predisposition to rain formation, it is improbable that cannonading of any kind can be regarded as likely to be uniformly successful in producing the wished-for showers. What meteorologists seem to complain of is that the Texas experiments were not carried out with that exact attention to scientific data which is desirable in the eyes of physicists hoping for exact information. All the same, it seems important that we should know more about the possibility (if such exists) of making rain at will, however, in this country at least, we have little or no practical reason to introduce any such experimentation in the way of rain production.

The Power of Water to Dissolve Glass

has recently been the subject of observation. The action in question may, however, be described as of a very feeble kind, relatively speaking; only it does take place. Recent investigations have been made on this solubility of glass by Herr Pfeiffer. By means of electrical action he was enabled to measure the extent of the dissolving action, and a result of the research was to show that a temperature of 20° C. glass was dissolved to the extent of from one to two millionths of a milligramme. The last is the ·015 of a grain in English capacity. Infinitesimally small as is the amount of glass thus dissolved, Herr Pfeiffer found that when the temperature is raised arithmetically, the dissolving action is greater than when it is raised geometrically. Later on, when a certain amount of alkali has been dissolved, we are told, the further process includes the dissolving of silicic acid also. It was shown in these researches that the increase in the conductivity of water for a given kind of glass under similar conditions is characteristic and of uniform nature.

With Brains, Sir!"

was the historic reply of Sir Joshua Reynolds to a friend who asked him with what he mixed his colours. It would seem, however, as if the inquiry in these latter days deserved a much more scientific reply than that given by the famous artist. For to-day artists are rather perturbed in mind over the question of the durability and lasting nature of the pigments they employ. It would, indeed, be a fatal calamity to art if the colours of valuable pictures are destined to fade and to alter after a lapse of a few years. Our pictures, in that case, will resemble somewhat the love letters written by a wavering swain, who, in possible fear of a breach of promise action, employed a patent "lover's ink," which was warranted to vanish away and leave no trace behind in an average period of fourteen days or thereabouts. Artists are perfectly right when they assert that modern chemistry should be equal to the task of providing them with permanent pigments; only it is a very difficult and laborious task, of course, to conduct experiments on paints and colour vehicles. A colleague of Dr. Andrew Wilson's on the Gilchrist Trust, Mr. A. P. Laurie, M.A,, of King's College, Cambridge, has for some years been working at the subject of the pigments used by the old masters, and his researches are in course of publication in the *Journal of the Society of Arts*. Mr. Laurie's investigations are made public in the shape of the Cantor Lectures, so that those who are interested in the question of the durability of pigments should consult the periodical in question.

How to Tell the Rate of Travelling by Railway

can be accomplished by anyone, with very fair precision, in the following manner :—The telegraph posts along a railway line in this country are placed thirty to the mile. There are, we need hardly remind our readers, sixty minutes to the hour, so that if the number of posts passed in a minute are multiplied by two, the result gives the number of miles per hour at which the train is travelling.

A House of Copper

has been constructed by an inhabitant of Brooklyn, N.Y. It is all of metal, on a light framework of steel, the floors being supported by arches. The walls are are composed entirely of large copper plates riveted together with double seams and bound with iron. The cornices, the fittings, the posts, the railings, and the sheathings are entirely of iron. The copper is not polished, but each plate is rough-hammered, Each plate makes a panel with the iron bindings. In three of these panels brass medallions are set in bas-relief. On the two tall brick chimneys are iron bas-relief work, one figure representing a phœnix. The style is Queen Anne, and time will colour the whole structure a rich copperas hue.

To Preserve Plants.

as botanical specimens the following method has been tried and found eminently satisfactory :—The method consists in dusting salicylic acid on the plants as they lie in the press, and removing it again with a brush when the flowers are dry. Red colours in particular are well preserved by this agent. Another method of applying the same preservative is to use a solution of one part of salicylic acid in 14 per cent. of alcohol by means of blotting paper or cotton soaked in it and placed above and below the flowers. Powdered boracic acid yields nearly as good results. In the case of delicate flowers they might be placed loosely between sheets of vegetable parchment before immersion in the liquid so as to preserve their natural form.

Twenty-two Hours.

from the poplar to the newspaper is the time estimated by Mr. Singerly, the proprietor of the *Philadelphia Record*, who makes up his calculation as follows :—Chopping one and a half cords of poplar wood, stripping and loading on boat, three hours ; time consumed in manufacture of wood-pulp, twelve hours ; manufacturing the wood-pulp into paper, five hours ; transporting to *Record* office, one hour and twenty minutes ; wetting paper preparatory to printing, thirty minutes ; printing ten thousand *Records* ten minutes. Total time from tree to paper, twenty-two hours.

The Science of Language,

as distinguished from phrenology, is, says a correspondent, not generally followed by English students. Its most devoted adherents are Germans. Prof. Max Muller, himself a German, has done much to interest British audiences in the mysteries of roots, the home of the Aryans, the affinity between Sanskrit and Greek, but without popular results. The origin of speech and the genesis of thought—such is the problem this science sets itself to solve. Upon its dictum the evolution of man from the brute, stands or is proven incomplete. Language is asserted to be the only barrier between "homo" and the animal. It remains for savants like Prof. Romanes and Prof. Max Muller to decide for us.

Perpetual Motion

has always been a pleasant *ignis fatuus* of the ages. There is reason to believe that in not a few instances the ingenious and complicated mechanism found in the clocks of past centuries, such as those by which descending balls for indicating the hours returned to their original position by means of hidden movements, were really the result of the endeavour by their makers to devise perpetual motion. Just as the labours of the alchemists resulted in serviceable chemical discoveries, so the chimerical scheme of securing perpetual motion may have led to various ingenious adaptations of mechanical principles in timekeepers.

A Pocket Fire Escape

is the latest thing from America. This fire escape consists of a metallic tape constructed of aluminium and steel, thus obviating all danger of its being destroyed by fire. The tape runs on a reel which is fastened to a web belt passing round the body under the arms. By means of a wood screw the tape is fastened to any object in a room or building. The reel is provided with a brake whereby the user can control the revolution of the reel and regulate the speed of his descent. There is also an automatic brake attachment which keeps any required tension on the reel so that it is an impossibility to descend too rapidly. The device weighs but three pounds.

The Horse-power of Whales,

together with the structure, habits, etc., of these mammalia, has formed the subject of an interesting study by Sir William Turner, the present eminent professor of anatomy in the University of Edinburgh, Scotland. He estimates that the great Greenland whale (average length fifty feet) attains a maximum speed, while swimming, of ten miles an hour ; the "Finner" whale (maximum length eighty-five feet) often making twelve to fourteen miles an hour. Mr. Turner, in one of his lectures, said that he and John Henderson, of Glasgow, the well-known builder of the Anchor line steamships, had spent much time in trying to arrive at a satisfactory conclusion as to the horse-power exerted by large species of the whale in making a speed of twelve miles per hour. As a base for their conclusions they took the size and dimensions of the great "Finner," which was stranded on the shore at Longuiddry some years ago. It was 80 feet long, weighed 74 tons, and had a tail which was 20 feet across at the extreme end of its flanges. With these data, Messrs. Turner and Henderson calculated that a whale of the dimensions mentioned, in order to attain a speed of twelve miles an hour, must exercise a propelling force of 145 horse-power.

The Best Isinglass

comes from Russia, where it is obtained from the giant sturgeon which inhabits the Caspian Sea and the rivers which run into it. This fish often grows to the length of 25 feet, and from its air bladder the isinglass is prepared. It is subjected to many processes before being ready for sale, but the Russians, knowing that it has the reputation of being the best, take great pains in its preparation, and in the world's markets it has practically no rival. A great deal is made along the Amazon, in Brazil, but it is very coarse and inferior, and is used for the refining of liquors and similar purposes. The adulteration of good isinglass with the inferior kinds can always be detected by placing samples in boiling water. The best isinglass will dissolve completely, leaving no visible residuum, while the inferior variety will show threads of fibrous tissue and be of a dark colour, often almost brown.

Parasitic Insects.

such as fleas and the like will, curiously enough, never trouble epileptic patients. Why it is, no scientist has ever been able to conjecture. It is well known that insects will leave dying people and can not be induced to remain on a dead body. The same antipathy seems to be shown by them to epileptics, and sometimes a flea or other insect placed on the hand of an epileptic patient will drop off suddenly as though paralysed.

The Trade Rats of Arizona

are a curious development of rodents, if all that is stated by observers of their habits can be relied upon. A miner near the Senator recently had a rather singular experience with these rats, which are known also as mountain rats. As the nights were cold the miner took his ore sack to replenish his rather hard bed. Having neglected to come to town for several weeks, his supply of beans had given out, and he had come down to a diet of bacon. Considerably out of humour, he started in to pull his bed to pieces one morning, and in removing the sacks was agreeably surprised to find three pounds of beans, with a little coffee mixed, which the trade rats had brought from the Senator and stored in his bed. The rats are native Americans, and very different from their imported Norway cousins. They are called trade rats because they generally leave some article in exchange for what they take away. The miner states that he never killed a trade rat; that these rodents habitually steal from one cabin and carry their plunder into an adjoining one; that on one occasion he spilled a couple of quarts of corn on the floor of his cabin, and the next morning found the rats had stored away every grain of it in a pair of saddle bags hanging upon the wall. He also states that the rats have thick caudal appendages, about three inches in length, which they keep constantly throwing up and down, striking the floor with each downward movement with the regular measured stroke of a musical professor marking time. They carry off plugs of tobacco, tooth brushes, combs, and brushes, in fact, anything they can manage to move.

The Lemming

is a little rat-like animal (like the rat, a member of the rodent or gnawing order of quadrupeds) found in Norway. It has always attracted a good deal of attention from the fact that apparently, at periodical intervals, it has been accustomed to migrate in huge swarms from its haunts, and to move in masses in a straight line towards the sea. In its course the lemming horde crosses lakes and climbs mountains, its numbers being lessened and thinned by the attack of natural enemies and by other means, until only a miserable remnant of the original swarm finds itself at the sea coast. There nothing further seems to occur by way of explanation of this strange migrating instinct. Naturalists, Dr. Andrew Wilson tells us, supposed that their habits led them to some former land area or surface, which served as a feeding ground or breeding place; the surface in question having disappeared beneath the waves, while the instinct still exercised its mystical force. Mr. Duppa-Crotch has lately contributed a short article on the lemming and its migrations, in the course of which he denies that the migration is caused by any scarcity of food—at least *now*. The young litters also "go singly on the journey, from which none have ever been observed to return." Mr. Duppa-Crotch tells us that they do not follow the watershed, nor do they migrate always to the west; "but'" he adds, "they do go straight." His explanation of the "apparently capricious and suicidal migrations" is that probably they are the result of inherited instinct which formerly may have been of service to the species; but how or why is a matter regarding which we do not seem to have any explanation to offer better than that of the vanished land of promise? The straight course, Dr. Wilson considers, is probably due to the exercise of the sense of direction common to migrating animals, although we seem to be presented here with an apt illustration of the power of an old instinct, no longer favourable, to decimate a species. Nature is not always a kindly mother to the children of life.

The Anatomy of Suicide

recently formed the subject of a most interesting lecture by Dr. B. W. Richardson. Mr. Richardson stated that there were living on this planet 1,480,000,000 of people. In the course of a year 33,000,000 die, or 62 per minute. Of those dying, 180,000 die as suicides, or at the rate of 5 per 1000 of deaths. In Massachusetts, figures just published showed that in a population of 2,238,940 with 43,528 deaths in a year, there were 196 suicides, or 4 per 1,000 of the whole mortality, and suicide was on the increase in that staid, sober, well-living state. Race had a great deal to do with suicide, the Teutonic race being more disposed to it, while it was rare among Jews, among the coloured African races, and Turanians. Among Scandinavians it was high. With regard to countries, it was lowest in Portugal, being 16 per 1,000,000, and highest in Saxony, where it was 469 per 1,000,000. England had been mapped out into three suicidal fields—London, Midland, and North, and very remarkable figures had been obtained with regard to different towns and counties. London showed one-third more than any other town in proportion to the population, and Middlesex gave 105 cases, to one in Merionethshire. Climate seemed to have very little influence, while season made a marked difference. Summer showed most suicides, and winter fewest, the maximum being attained in the latter part of June and the minimum in February.

With regard to Religion and Suicide,

Protestants stood far above other sects, as shown by figures taken from the year 1849 to 1884. Then as to education, it was a strange fact that suicide ran with education in all countries where facts had been collected. All occupations of a competitive character, inducing excitement, increased suicides, which were also frequent just after a war. France showed that wealth and competency did not prevent suicide. Women more often committed suicide on Sundays and men on other days. As to age, males generally averaged from thirty to forty, and females from twenty to thirty. Late in life the tendency passed away. The nervous and lymphatic temperaments were most disposed to suicide. Widowers were more prone to it than widows. Then as to the causes. There were the insane, those who killed themselves in a delirium; the melancholic, who had the tedium vitæ; those who desired to die, the monomaniacs; others with a maniacal impulse; while heredity was a strong predisposing cause sometimes. Then there were the same suicides—who showed no insanity, were carried away by a sudden impulse, or made a deliberate choice of evils; or who, belonging to the pessimist school, argued that they had a right to end their life if they chose. Among determining causes were alcoholic excitement, religious doubts, and a variety of others. The best remedies were temperate life in all departments, abstention from distracting dogmas, and moderation in the scramble for education.

SCIENCE QUERIES AND ANSWERS.

A prize of two shillings and sixpence will be awarded for every interesting question asked by our readers and published in this column and five shillings will be given for every answer published. In all cases when a similar question or reply is sent in by two or more correspondents, the award will be given to the one whose letter is first opened, provided the subject is properly treated. Questions asked by correspondents and not replied to by our readers, may, if of sufficient interest, be dealt with Editorially.

Rules for Competitors.—(1) Only one question may be sent each week, but any number may be answered. (2) Write on one side of the paper only. (3) Envelopes must be marked "Science Queries and Answers," and must arrive not later than the Monday following date of publication.

7.—Of what are artificial teeth composed?

They are made from a mixture of 1 oz. kaolin to 3 oz. silica, 18 oz. felspar, and 65 grains oxide of titanium. This compound, which resembles the basis of porcelain ware, is moistened and forced into suitable moulds. It is afterwards baked in a furnace at a high temperature, and glazed with an enamel composed of 1 oz. felspar, 1 dwt. borax, and 1 grain of platinum sponge.

8.—What quantity of alcoholic liquor, if taken at one time, would be sufficient to cause death?

In the case of a child below ten or twelve years of age, about 2 oz. of absolute alcohol contained in brandy or gin, etc. To adults, it is said that about 5 oz., or even less, absolute alcohol, in the same form, would be probably fatal. In these cases, however, the mere local action of strong alcohol on the mucous membranee of the stomach, etc., would exert considerable influence.

9.—In what way are blood stains recognised upon clothing?

The stained clothing is boiled with some glacial acetic acid and a small crystal of common salt in a watch glass. On cooling, "Teichmann's crystals" of hanim separate out in the form of triclinic plates and prisms in star-shaped clusters of a dark brown colour. These crystals are insoluble in either water or alcohol. Blood can also be distinguished by the aid of the spectroscope.

10.—What constitutes the difference between a plant and an animal?

The cell, composed of protoplasm, is the structural unit of all living things. It consists of a mass of material of jelly-like consistency, inclosing minute granules of various kinds, and an important structure of more solid consistency known as the nucleus. The lowest animals and plants with which we are acquainted are composed of single cells. But even the highest were originally unicellar, as, for example, the human ovum. It is, therefore, in the structure of the cell that the most fundamental difference between these two classes of living organisms must be found. The ultimate constitution and structure of cells has not yet been determined in any single instance. I may say generally, however, that outside the protoplasm of the vegetable cell there is usually an investing membrane, composed principally of cellulose, and known as the cell wall. The reverse is the case in animal cells. Then again, plant cells contain chlorophyll—a green pigment by which food is assimilated under the influence of radiant energy. Animals, on the other hand, receive their energy in only a small degree from radiation, but largely in the form of vegetable food, *i.e.*, of the substances formed by synthetical processes during plant life. Thus in plants we have vital energy derived primarily, but in animals secondarily from the same rays.

11.—How much power is concerned in a great boiler explosion?

In steamships having engines of 12,000 horse-power, the boilers contain not less than 3,000 million foot pounds of heat energy, or enough, were it liberated by explosion, and applied in a vertical direction only, to lift the ship, cargo, and crew over 100 feet into the air.

12.—What is the amount of power contained in a given quantity of steam, and how much of this can be practically utilised?

A pound of steam, at a pressure of 100 pounds per square inch, possesses one and a quarter million of foot pounds of energy, which is equal to about forty horse-power exerted during one minute. In a perfect engine, about four pounds of steam per horse-power per hour would be used, but practically from thirty to fifty pounds are required.

QUERIES.

13.—What is the most accurate method of keeping time?
14.—Can a liquid be made to vibrate like a spring?
15.—What is the best anti-fouling composition now in use in the navy?
16.—I have a "Newton's disc" coloured red, orange, yellow, green, blue, and violet. On rotation it gives a grey instead of a white. Can I improve it?
17.—How is the electric resistance of stranded cables calculated?
18.—Is it possible to eliminate the action of gravity in physical experiments?

NOTICE.

Owing to the many complaints we have received from Competitors to the "Science Queries and Answers" Column, we have decided to allow a longer interval for sending in replies, and for this purpose we return to our original day, the Monday following publication. This will prevent our publishing any replies in our next issue, but they will duly appear the following week. Thus Competitors will have six clear days in which to answer questions, and our examination will be more thorough as we shall also have an extended period in which to deal with the correspondence. All replies to the questions published this week, must, therefore be sent in by first post next Monday, and replies will appear on the following Tuesday week.

COUPON COMPETITION.

The award in this competition has been given to Miss L. Dudleigh, 43, Upper Bedford-place, Russell-square, W.C. The number of coupons sent in was 811.

JANUARY.

Many interesting insects and larvæ may be observed, says *Child Life*, even in severe weather, such as Caddis worms, waterman beetles, larvæ of Mayfly, and dragon flies, skeleton or phantom larva of the Corethra Plumi corniseto. The fresh-water shrimp hybernates in extreme cold; water snails, the common leech, seek the bottom of the pond, and earthworms burrow deep from severe frost. In London, during January, the following birds have been noticed: Starlings, thrushes, redwings, blackbirds, robins, hawfinches, blue tits, ox-eyed tits, wrens, cole tits, chaffinches, sparrows. Spencer says, January carries "a hatchet keene with which he felled wood, and from the trees did lop the needlesse spray." Forster's "Perennial Calendar" says: "Buds and embryo blossoms in their silky downy coats, often finely varnished to protect them from the wet and cold, are the principal botanical subjects for observation." Beans, peas, radish, spinach, should be sown this month.

GLEANINGS OF THE GLOBE.

A RAFT of 1,000,000 feet of logs recently crossed Lake Huron in seventy-two hours, and a raft of 4,000,000 feet is now building.

THE Boulder Committee of the British Association reports that in some districts boulders are being destroyed so rapidly that many described in former reports have disappeared.

TWELVE months after the Queen's accession, 400 lbs. of Indian tea were sent to England as an experiment. In 1890 the consignment was over 100,000,000 lbs., and Ceylon sent nearly half as much.

THE average speed per hour for a term of eight months of six of the ocean greyhounds ran from 19·02 to 18·15 knots per hour. The coal consumption is about one and three-quarter pounds of coal per indicated horse-power per hour.

ELECTRIC welding has been reduced to the utmost exactness in shops where formerly all the clumsiness of fire-welding prevailed. Leader water pipes may be welded butt joints on. The use of a flux is not necessary.

To get a good polish on mahogany easily: Mix one part of boiled linseed oil with two parts of alcoholic shellac varnish. Shake well before using. Apply in small quantities, with a cloth, and rub the work vigorously until the desired polish is secured.

IT has been discovered by a Moscow scientist that the white poplar (populus alba) can be used as a natural lightning rod, and he has submitted a memorial to the Minister of the Interior, suggesting that the planting of a white poplar before every house in the village be made obligatory upon the owner.

To mend meerschaum, nothing is better than a caseine cement. To make this cement, boil fresh cheese in water until it is ropy. Dissolve it in water glass or solution of silicate of sodium, stir into it calcined magnesia, and use at once. Use equal weights of cheese and water glass solution, and as much magnesia as will mix with it.

IT is reported that a new French cigarette paper has been brought out by MM. Appel and Co. It is made on a principle of being perfectly tasteless. After numerous experiments the inventors have decided upon putting into the pulp a certain proportion of Vichy salts, which are not only inoffensive but possess the requisite qualities for use.

A YOUNG man camping in the Sierras, in America, discovered and captured a butterfly of an unusual species. He sent it to the Smithsonian Institution at Washington and received a cheque for 1,500 dols., with the request to make careful search for other moths of the same species, supposed to be extinct, and great was the excitement among scientists at the discovery that one of the race had been recently alive. Although diligent search has been made by men paid for the service no other specimen has been found.

ONE of the wonders revealed by the microscope is that human hairs possess a marked individuality. Not long ago, a single hair—the evidence in a murder case—was shown Dr. Jeserich, with the request that he determine whether it was from the head of the supposed murderer, whose hair was of the same colour. After examination, the specialist decided that it was sufficiently unlike those of the suspected man to acquit him. The real murderer was subsequently captured, and his hairs were found to be identical in character with the one first examined.

AMONG the features of the Columbian Exhibition to be opened at Madrid, in September, will be an American historical exposition, which is intended to reproduce the condition of the different countries of the new continent before the arrival of Europeans, at the time of the conquest, and down to the first half of the seventeenth century. It will include all kinds of objects, models, reproductions, plans, etc., relating to the peoples who inhabited America then, and to all those who had to do with the navigators.

ARGAND, the inventor of the lamp which bears his name, had been experimenting for some time in trying to increase the light given out by his lamp, but all to no purpose. On a table before him one night lay an oil flask, the bottom of which had been accidentally broken off, leaving a long-necked funnel-shaped tube. This he took up carelessly and placed it, almost without thought, as he afterward related, over the flame. A brilliant white light was the magical result, and the hint was not lost by the experimenter, who proceeded to put his discovery into practical operation by "inventing" the glass lamp chimney.

MM. LEO VIGNON and P. Sisley have been studying the phenomenon of the yellow colour which is imparted to silk by nitric acid, and have discovered a number of facts which may have an industrial value. It appears that nitrated silk does not deflagrate, but, if subjected to the action of heat, carbonises and evolves an odour of burnt horn. It blackens more rapidly than the unnitrated article. Nitrated silk comports itself like ordinary silk with respect to solvents, but in concentrated sulphuric acid it swells up, and yields a viscid mass comparable to the albumen of an egg.

THERE are regions of the globe where nearly every rain storm is accompanied by violent electric explosions, while in others thunder and lightning are as rare as earthquakes. The worst climate for persons affected with a nervous dread of lightning is the east coast of San Domingo, where the sky at the beginning of the rainy season is often illuminated for weeks by nearly continuous electric twinkles and flashes. In Western California, on the other hand, the equilibrium of atmospheric electricity is so rarely disturbed that many old residents of San Francisco have never heard a good thunder-peal of the traditional window-shaking variety.

A STORY is told of Robert Emmet, which proved his secretive power and resolution. He was fond of studying chemistry, and one night late, after the family had gone to bed, he swallowed a large quantity of corrosive sublimate in mistake for some acid cooling powder. He immediately discovered his mistake and knew that death must shortly ensue unless he instantly swallowed the only antidote-chalk. Timid men would have torn at the bell, roused all the family and sent for a stomach-pump. Emmet called no one, made no noise, but, stealing downstairs and unlocking the front door, went into the stable, scraped some chalk which he knew to be there, and took sufficient doses of it to neutralise the poison.

SANITARY SCIENCE.

Look to your Drains!

The importance of sanitary science is not fully appreciated by householders. It is a subject that requires but the slightest modicum of common sense, and yet, we regret to say, that common sense is rarely or never brought to bear on it. People take houses on long leases or agreements, and, as a matter of course, pay a substantial fee to a surveyor for the inspection of the sanitary arrangements in the new dwelling. And there the matter ends. They never take the fact into consideration that it is just as possible that leakages may arise in pipes, that traps may become disordered, and that accumulations of sewage may occur during their tenancy, as well as during the tenancy of their predecessors. They are entirely oblivious of the eroding nature of sewage and sewer gas, and seem to be ignorant of the fact that disintegration is constantly taking place in their drain pipes through corrosion, the result of chemical action. These same drain pipes may, therefore, become leaky at any moment, and we all know what a leak in a sewer pipe means. Probably an attack of some virulent fever. It is lucky when this is the worst that happens. We say "worst" advisedly; for the leakage may be so gradual and so imperceptible to the olfactory organs that no one is aware of its presence, with the result that entire families find themselves beset with unaccountable lassitude, weakness, brain fag, indigestion, sores, bleared sight, and countless ills that medical men in vain endeavour to account for, and vainly strive to remove by potions, tonics, and such like. All is futile, for the little invisible enemy arising from the drain pipe is never thought of, as it noiselessly but surely performs its cruel work. Why should it be thought of? "We had our drains thoroughly examined by a surveyor when we took the house, seven years ago," is the usual rejoinder of people when the infallibility of their sanitary arrangements is questioned. Seven years ago! It might as well be seventeen, or seventy years ago, for all the use such an examination is at such a period. Drains require inspecting at least twice a year. Six months is quite a long enough period for sewage to find out the weak spots in joints and pipes.

With all these facts before us, and in view of the terrible ignorance about sanitary matters evinced by the public, and its helplessness to procure proper sanitary inspection for dwelling-houses, we have determined to do something more than preach. In short, we have decided to help the public to help itself. Co-operation is the backbone of all public enterprise, and by co-operation our readers may now have their sanitary arrangements inspected by qualified sanitary engineers at such a price that the cost can never be felt. Those who hesitate at the slight expenditure that we propose will not only show an indifference for their own health, but will be acting almost criminally towards those for whose welfare they may be responsible. Apart from this, we advocate the scheme on the grounds of economy. What does a serious illness imply in the matter of doctors' bills? Certainly ten pounds, perhaps a hundred, perhaps considerably more, Aye, and may be our neglect of simple sanitary precautions may mean the lifelong suffering of those near and dear to us, or even the sad procession to "God's acre." The winter is now on us with its chills and trying variations of temperature. Our systems are all the more liable to succumb to these influences, if they are undermined in the first place by dwelling habitually in tainted atmosphere. The blood is impoverished, and we are physically weak through our indifference to nourishment which too frequently results from the unconscious inhalation of sewer gas. It behoves us, then, to "look to our drains!"

We would refer our readers for further particulars respecting this scheme to p. 240, in the current issue. We shall at all times be glad to receive suggestions respecting the "Science Sanitary Association."

AN INGENIOUS WEIGHING MACHINE.

About 200 years ago there lived a Prince of Mahrattas, in Hindostan, whose name was Shahjee. Princes are numerous in India, but this particular prince was long remembered on account of his beneficence and great wisdom. He seems to have been the most learned prince of the time, and his advice and help were always sought in critical matters. Many stories are told of his ingenious settlement of difficulties, and some of them are certainly curious.

Once a very high official in the court of Prince Shahjee made a vow that if he succeeded in a certain enterprise he would distribute to the poor of his district "the weight of his own elephant in silver." Elephants were highly prized by these princes, and each kept the largest and finest for his own use. The official's vow, if hasty, was generous, and perhaps the success of his undertaking was worth the price.

The undertaking succeeded, but the official, willing to keep his oath, was met by an unexpected difficulty. There was no possible way of finding the elephant's correct weight. No scales in the country were constructed of sufficient power to weigh such enormous beasts. Elephants were not sold by the pound, and no need had before arisen for scales to weigh them. All the learned and clever men of the court tried in vain to construct a machine of sufficient power to weigh the enormous beast. It did seem probable that the poor of Hindostan would have to get along without that silver. It is possible that the official had thought of this objection when he made the vow. Indians are crafty, and this one might have been cunning enough to leave himself a loop-hole of escape to prevent parting with his money.

But if any such notion had occurred to him he was doomed to disappointment in the matter. The question was referred to Shahjee, as all such vexatious questions were. And it did not take him long to find a very simple solution. That is always the way with true genius. The solution it finds is so simple that every one cries out in wonder:

"Why, of course! Why didn't somebody speak of that before?"

Shahjee commanded the elephant to be conducted along a platform into a flat-bottomed boat, which lay by the water-side. When the animal was safely aboard, he desired the attendants to mark upon the boat's side the exact height to which the water reached when the elephant weighed it down. Then the elephant was taken out and stones substituted, until enough were loaded into the boat to bring it to the same water-line, as when the elephant was the passenger.

Then the stones were weighed. If the scales could not hold all at once, part could be taken at a time, and so the elephant's weight was correctly ascertained. It is safe to conclude that the poor of Hindostan finally got the silver. A prince so wise must have also been just. Whether the official who paid the money was quite satisfied, history does not tell us, but we will hope, for his charity's sake, he was; and as a full-grown elephant weighs several tons, the amount distributed among the poor of the district must have been very arge

THE TIDES AND THE STARS.

One of the most interesting steps in the wonderful advance of astronomy during the last forty years was that taken a few years ago by Prof. George H. Darwin in his investigation of the effects of tidal action in the evolution of the solar system. According to Prof. Darwin's conclusions, the moon was born directly from the earth in the molten stage of our planet's history, and at the beginning of its career revolved rapidly around the earth at very close quarters. At that time tremendous tides were raised upon each of these plastic masses through the attraction of the other. By means of reactions, which can be demonstrated readily with simple geometrical figures, although their full analytical investigation is an intense mathematical process, the effect of the tides is both to drive the moon gradually away from the earth, causing it to revolve constantly in a larger and larger orbit with decreasing angular velocity, and to slow down the rotation of the moon on its axis, until it reached the condition in which we now behold it, keeping one face always toward the earth, and making but one rotation on its axis in the course of a revolution around its terrestrial centre.

Within the past year or two it has been discovered that Mercury and Venus, the only planets of our system which are nearer to the sun than the earth is, behave in a manner analogous to that of moon, so far as their rotation is concerned. They always keep the same side toward the sun, just as the moon always keeps one face toward the earth. It is not improbable that these planets may have been brought into their peculiar condition by the effects of tidal friction, although the problem presents great difficultics.

Quite recently an attempt has been made to apply the principle of tidal evolution to those wonderful solar systems known as the double or binary stars. Mr. T. J. J. See, of Berlin, has made a mathematical investigation along this line which leads him to some exceedingly interesting conclusions concerning the constitution of the universe. In a binary system there are two suns, often far exceeding our sun in magnitude, which, held in comradeship by their mutual attraction, revolve around their common centre of gravity, carrying their families of planets, if such they have, round and round in ceaseless gyrations. One remarkable feature of such systems is that the orbits of the revolving suns are exceedingly elongated ellipses, differing in this respect very widely from the nearly circular orbits of the planets in our system. Another feature is that, while one of the members of the combination is almost always noticeably smaller than the other, yet in no case is the disproportion of magnitude anything like so great as that which exists between even the largest of our planets and the sun.

Both of these peculiar features of the binary stars are explained by Mr. See's hypothesis. He concludes that the fact that the two stars are always comparable in size indicates that they owe their origin to the splitting up, through the effects of rapid rotation, of a condensing nebulous mass which was nearly homogeneous throughout its volume. He shows, mathematically, that the greater the departure from the absolute homogeneity in the parent nebula, the wider the difference in magnitude of the two masses after the separation would be. His investigations lead also to an explanation of the highly eccentric orbits of the binary systems, by showing that the effect of tidal reaction between the two masses after separation had taken place would be not only to drive them gradually apart, but to increase the eccentricity of their orbits.

Perhaps the most interesting thing that Mr. See points out as a deduction from his investigations is that we cannot take our solar system as a type of solar systems in general. The smallness of our planets in proportion to the sun, and the near approach to the circularity of their orbits, indicate that our system resulted from exceptional conditions, which, perhaps, have not been precisely duplicated. This conclusion will undoubtedly be welcomed by those who hold with those scientists who claim that ours in the only inhabited world, and yet, surely, proof of the infinite diversity and variety of the universe cannot militate against the belief that nature is as perfect in binary systems and in sun clusters as in our little corner of space.

SUN SPOTS.

To the Editor of SCIENCE SIFTINGS.

SIR,—I beg to ask your opinion (through SCIENCE SIFTINGS) about sun spots mentioned in the book "The Story of the Heavens," by Sir Robert Stawell Ball, F.R.S. On page 33, fig. 13. we get a diagram showing observations of sun spots by Scheiner, the astronomer. There are 13 spots and half a space, this is the actual progress of $12\frac{1}{2}$ days across the sun's face. Now those figures are doubled, and he gives us the rotation of the sun on its own axis in 25 days 5 hours, or about that.

Now these spots disappear at the edge of the sun, and it is stated that they re-appear on the other edge in about $12\frac{1}{2}$ days. Now, if this was the case, then the sun would be as flat as a piece of paper; but if the spot re-appears in 17 days 17 hours, then the sun is a globe like our earth.

Can an observer on the earth see half the sun's face, and a similar half be obscured from his view on the back of the sun? I think we shall have to take three views to see any circular object—from an orange upwards. More especially an enormous body like our sun, with its 866,000 miles diameter.

Now, Sir, to prove this, I took an orange, and made a proper girder for it; I then marked out 26 spots on my girder, to represent the 25 days, and I had a small space to answer for the 5 hours. I then placed my orange on the mantel, and, to my astonishment, I could only see eleven spots and half space; I turn round my orange, and count 15 spots, half space, and space for five hours.

My next step was to increase the number of my spots to 32 and space for 5 hours. This done, I now place my orange on the mantel, and find that 13 spots are visible with the half space. These spots are in the same position as represented in drawing, page 33, fig. 13.

I now count spots on other side of orange and find them $18\frac{1}{2}$ and 5 hours.

Thus we have:

Visible spots	-	$13\frac{1}{2}$	
Invisible ,,	-	$18\frac{1}{2}$	and 5 hours.
Total	-	32	5 hours.

The $13\frac{1}{2}$ spots represent $12\frac{1}{2}$ days.
The $18\frac{1}{2}$,, ,, $17\frac{1}{2}$ days.
The small space represents 5 hours.

Rotation of the sun on its own axis, 30 days 5 hours.

With closer observations than those of Schiener, it may in future be proved to science that the sun rotates on its own axis in the same time as the moon revolves round the earth.

The sun in the past has been the last, but in future science must be first, and all measurement be taken from it.

I remain, Sir,
Yours truly,
THOMAS BOWKER.

THE SPECTROSCOPE.

It is not too much to say that the spectroscope has done more for science than any invention of modern times. An elementary knowledge of its use and principles must be of interest to all, and of utility to many. Mr. J. Cerridfryn Thomas, B.Sc., recently published some most interesting observations on the subject, in the *Cardiff Times*, in which he much regretted that Dr. Huggins, in his much-reported address at Cardiff, should have assumed the possession of any elementary knowledge by his audience—an assumption which he would probably not have made if he had been addressing the reading public.

But without some knowledge of the apparatus the facts supplied in the address, however important and interesting, will partake of the nature of credenda—matters for belief rather than realisation. It is to be feared that it is becoming a fashion to adopt the great facts of natural science as articles of faith, and, however much this may be defended, it is not true culture. The mind is not merely an aggregate of pigeon-holes for the retention of facts, but an instrument capable of indefinite development in power and precision.

Even in respect to the telescope, the prevailing notions are the crudest possible ; for example, that the moon is seen through it as a cow is seen through a window—being in innocent ignorance of the wonderful laws of light which determines the formation of magnified and diminished images. This self-complacency with the crudities of knowledge need not be so general if modern advantages were sufficiently availed of.

If this be so with the telescope, which has been familiar to the public for many years now, how much more must it be true of an instrument which is only a child of yesterday.

The branch of the science of light with which the spectroscope is concerned is called spectrum analysis. The not familiar instance we get of a spectrum is in the rainbow—the band of seven colours, into which white light is split up by the rain as it falls, under favourable conditions in respect to the sun. In the rainbow we have a spectrum bent into a semicircle—an instance of nature's own spectrum analysis—carried out, according to her fashion, on a gigantic scale, awakening our admiration for its inimitable grandeur, as well as for the simplicity of its spectroscope, viz., a shower of rain-drops.

Literally the word spectroscope would mean an instrument for viewing and examining the constituent parts of this coloured band. But in reality it is more than this. It is an instrument intended, in the first place, for forming a spectrum, and then for inspecting it when formed. For a falling raindrop is only *one* out of many methods of effecting this analysis of a beam of light. Another is to pass it through a glass prism of triangular section, like the drops of a chandelier ; and if this beam on emergence from the prism be allowed to fall on a screen in a darkened room, we get a broad band of rainbow colours—it is a rainbow minus the bow or bent form. This method was discovered by Newton, and is the one commonly adopted in the construction of the spectroscope. So far it is an instrument for giving us information respecting the constitution of light. Now the question arises—how comes it to be a means of furnishing us with facts concerning the source whence the light proceeds ? How is the astronomer by its aid able to ascertain what elements are present in our great luminary, the sun, and other heavenly bodies ? A detailed description is, of course, outside the compass of a short article, but the principle involved may be thus briefly stated :—

By way of a preliminary illustration, let the reader strike a pitch-fork and bring it to an open piano, and it will be observed that one of the wires will be made to vibrate and give forth a responsive sound. By a little further attention it may be discovered which of the hidden wires it was that became thus effected. It depends altogether on the pitch-fork used. Thus, if it be a C fork that is struck, a C piano-wire will take up the vibration and reproduce the sound ; and if it be an A fork an A wire will sound, etc. ; that is, generally, the wire that can swing or vibrate in perfect unison with the fork, or, in other words, the wire that makes a complete oscillation in the same time as the fork. The explanation of this is that the energy given out by the vibrating fork is transferred by means of aerial waves to the susceptible wire, and under the accumulating effects of these it at last sounds loud enough to be heard. We meet with a very similar phenomenon in light. If the source of light be an incandescent solid or liquid, the rainbow it forms possesses all the seven colours (viz., red, orange, yellow, green, blue, indigo, and violet), and is continuous from the red to the violet ; whereas that given by the same substance in the gaseous condition is not white and continuous, *i.e.*, does not emit white light ; and when it is analysed by the prism the rainbow band it supplies is incomplete, broken, and discontinuous, consisting, for example, of a part of the red and the violet ends, the intervening colours being wholly or partly absent. This is called a discontinuous spectrum or a spectrum of bright lines. Now, what is important to note is that each substance, when in the state of an incandescent vapour, has its characteristic colours, and emits rays of a colour peculiar to itself ; the well-known example of this is that of sodium vapour, being always a definite part of the yellow.

If the reader has followed thus far and has firmly grasped the facts that a glowing solid or liquid gives a rainbow band with all the colours—a continuous spectrum—and that glowing gases on the other hand yield only fragmentary colour-bands—a discontinuous spectrum—he is fully prepared to understand the remaining points of explanation. If so, we may move on to the next step, namely, that if a beam of light proceeding from a glowing solid or liquid be made to pass through a gas at a lower temperature than the source, those rays (and those only) which the gas itself in a glowing state would emit are now quenched—their energy being absorbed as they pass through ; hence this element of the beam is absent in the spectrum, and its place is occupied by a dark line ; or, in other words, there will be a dark line in that very place where we should get a bright one from that particular gas if the light proceeded from the gas itself, and not from an independent source beyond it. As we gaze in deep admiration at the celestial arc of brilliant hues which, at morn and eve, when our great orb of light is at the required angle above the circle of the horizon, spans our heavens, presenting to our view a mysterious vision which non-plussed our forefathers and ourselves in youth—how little we think that it is crossed by thousands of these dark lines, each of which has a tale of bewitching interest to tell about that distant orb. But this becomes its most prominent feature when examined under the favourable conditions afforded in the epoch-making apparatus—the spectroscope. Each black line is a little tell-tale, divulging to us by its tale of loss and suffering, what it has met on its march in the solar atmosphere after quitting the glowing mass of the sun. From these considerations it is evident that the spectroscope and its startling revelations of the physical conditions of distant worlds deserve, and will certainly reward, the attention and study of all lovers of the knowledge of Nature and her workings.

THE WARFARE OF SCIENCE.

The great foe to science, it is not too much to say, has been theology. To say this is not to cast doubt on true theology; it is merely to affirm that, in point of fact, the particular theologies that have heretofore occupied the ground have one and all felt themselves threatened by science, and have set themselves to resist its advance by every means in their power. We see no reason why this fact should not be frankly recognised. In the natural course of things theology deals in imaginative fashion with questions of origin and development; and until exact knowledge begins to prevail the notions thus established serve a more or less useful purpose. As knowledge grows, these conceptions are found to be faulty; but theology resists any change—in the first place, from a general conservative instinct, and, in the second, because the cause of moral and social order seems to be more or less involved with the primitive cosmogony. But when once man has begun to observe, to compare, to verify, and to record, he has laid a foundation that cannot be shaken, he has sown a ferment that must grow and spread till it has leavened the whole of human thought. Systems founded upon imagination must yield to those produced by the use of the reasoning faculty. They were no better than guesses at the first; and if they furnish an adumbration, however vague, of the truth, it is almost more than we have any right to expect. Reason itself errs in many of its constructions, but it faces the light, and year by year and age by age it is able to perfect its work.

We fail, therefore, to see why any of our religious contemporaries should take in evil part the really instructive treatment given to this subject of the perfecting of science through opposition and conflict. They really need not feel too bad about it. In a certain way it was good for science, just as it was for the great Psalmist, to be afflicted. The natural reluctance which men of science felt to find themselves at variance with established beliefs, armed with the power of persecution, led them to scan their theories very carefully before giving them to the world. Moreover, the very difficulties of the situation drew out much heroism of character, and made science more conscious than it would otherwise have been of its moral and intellectual mission. Whether in these comparatively peaceful times the work of science is done in as high and noble a spirit as formerly is perhaps open to question.

The lesson which nearly all sensible men draw from the history of science is simply this, that the enlightened reason of man is the only interpreter of Nature's laws, and that physical theories handed down from remote antiquity have simply no claim whatever upon our acceptance in the present day. It matters not whether a misapplied ingenuity can find in them some distant resemblance to known facts, any more than it matters, when a weather prophet guesses at the weather, how near the mark or how wide of it his guess may fall. In the present day we have done with guessing in matters scientific. We may frame hypotheses, but, if so, their destination is to be confronted with facts; and if they cannot abide the test we let them go. Some of our theological brethren are given to gloating over the mistakes made by scientific men, and point with triumph to the wrecks of scientific theory that lie along the highway of the world's thought. There is little justification for the triumph. No scientific theory ever perished except to give birth to a better. It would be nearly as sensible to take a man to some ancient cemetery and taunt him with the number of his dead ancestors. In humanity is the living germ which persists from age to age, though the generations of men fall like the shed leaves of the oak, and so with science—theories and systems may fail, though not till they have served their purpose; but science as a method, as a principle, as a power survives. and from generation to generation admits us into ever more intimate recesses of Divine Nature's temple. Theology, too, it is sometimes said, is progressive, and, in a certain sense, doubtless it is. But in what does its progress chiefly consist if not in giving up a fruitless contest with science, and recognising the perfect independence of the latter as an interpreter both of Nature and of man? If theologians are wise they will not only renounce for ever the ancient conflict, but they will endeavour to make an ally of science and to impress upon it, to the utmost of their power, a moral aim. The business of science is not to deprive the world of religion, but rather to make religion possible for all men by removing the intellectual difficulties that have in the past more or less hindered its acceptance by enlightened minds. When the voice of authority is no longer raised to stifle intellectual inquiry, science will cease altogether to wear a negative aspect, and will gain universal recognition as the great constructor of whatever is sound in knowledge or of practical value in life; while religion will embrace the emotions and convictions come to man from the contemplation of the all-comprehending universe and its Transcendent Cause.

THE WORLD OF METALS.

There is going to be a big display of metals at the World's Fair in Chicago. It ought to be most interesting to every one who realises what an illustration of human progress will be thus afforded. One hundred years ago the known metals were only a few compared with the many that mankind is acquainted with and utilises to-day. Continually the chemists are discovering new ones, and for each addition to the list valuable uses are found, so that the wonder is how they could ever have been dispensed with.

Take the case of aluminium, for example. Ten years back it was so precious that jewellery was made of it. Steadily the improvement of processes for extracting it from its ores has gone on, until it can be turned out at about four shillings a pound. The day when steamships and bridges will be built of it is said to be near at hand. Being almost as light as chalk, not susceptible it is generally claimed to corrosion, and with a tensile strength superior to that of steel, its value for mechanical purposes is inestimable. In Germany various art objects are now made from it largely, such as statuettes. Attempts have been made to introduce it as a substitute for silver in the manufacture of spoons and forks, but with only partial success, owing to its slightly greasy feel, which is due to a thin film of oxide of aluminium on the surface.

Besides aluminium there will be shown at the fair, gold and silver in big lumps, as well as tin, zinc, copper, iron, and nickel. Also there will be antimony for type metal, chromium for making chromo steel, iridium for tipping gold pens, magnesium for magnesium lights, cadmium for alloys, potassium and sodium for chemical industries, manganese for making iron non-magnetic, and bismuth, which melts at a point so far below the boiling water that moulds can be made from it for taking casts from the most destructible objects. All these metals are numbered among the primary elements which compose the earth. Of these elements sixty-nine have already been discovered, not to mention two or three more which are doubtful.

A PINT of water converted into steam occupies as much space as seventeen hundred pints of water.

THE SCIENCE OF IMAGINATION.

The power of the imagination is something astounding, probably because we do not yet know what the imagination is. Let us at least set it down firmly that it is not a mere dreamy fancy, but certainly a very creative force. We imagine only when we see, and if that thing seen is not a fact, it may be something greater than a fact —a truth. The history of science shows that all the great laws of mind and matter have been discovered, not by demonstration, but by imagination. Darwin saw evolution before he had it proved. The correlation of forces was imagined by three different men in as many different lands, and then worked out.

When the Christian scientist is charged with too much imagination it is easy to defend him by saying there is great probability that this highest power of the mind is very capable of working miracles with a lump of clay, even when it is organised as a human body. At all events we know that if our health is not a result of the power of the imagination, most of our sickness is. It would be well to reverse the statement, and say that if faith does not heal, imagination kills. If we analyse these two ideas, faith and imagination, we find they come very close together. They are both a strong conviction or belief. So we find that we can argue ourselves into feeling comfortable or uncomfortable ; perhaps positively ill or positively well.

A domestic servant went to a druggist in haste to have a prescription made up of 2 ounces of aqua pura, plus 2 grains of morphine. The patient for whom the dose was intended was the head of a family and was suffering severely with neuralgia. The family physician who wrote the prescription happened to be in the chemist's shop as the manager appeared. The druggist put up the prescription and labelled it in accordance with the required elements. But some time afterwards he found the morphine on his scales—he had sent nothing but water. He asked the doctor what could be done to correct the mistake. "Why, not anything," said the physician. "I'll wager the aqua pura will work as well without the morphine." And it turned out that it did. The patient, an intelligent, highly-educated man, was sleeping as soundly as a babe after the second dose of pure water. It naturally follows that we should note that this was a case of faith-cure, and that the doctor was a faith curist, as most of them are. Was it honest for him to dose his victims with morphine if he believed that water and belief would do just the same work? It was a case of the imagination taking hold of the body to free it of pain. It needs no further demonstration of the ability of a man, who can secure the confidence of his patients, to work miracles. On the other hand, it is clear that a great deal of the misery and disease of the world is worked by our faith in bad persons.

The power of mind over physical conditions is the power of ideas over things. There is an old story of a court fool who was condemned to death by the sword. The duke who condemned him, however, only intended to play on the fellow's fears. He ordered the executioner, after some awful scenes of trial and condemnation, to use a sausage instead of a sword. But all the same, the man fell to the ground—dead. Hypnotism is based on the same power of the imagination to direct and create physical conditions. One writer speaks of "a certain part of the skin touched by a harmless instrument, or a finger, and after awhile an inflammation appears at the very same spot, reproducing the exact form of the contact." Here the power of the mind travels so far about by an unconcious path that the results seem miraculous. We recognise (1) the power of mind over matter ; (2) of will directly over persons or things, but (3) later facts lead us to see the power of mind very indirectly over the powers of assimilation and secretion, over the construction of bodily tissues, and over their destruction. There is now no longer any doubt but that we can control, to large extent, what are called our unconscious functioning ; may even shape and reshape our organism within certain bounds. Suggestion of another person's will, it is found, may be the only aggressive force acting on and through our own passive personality, and so causing blisters or healing sores. We are just at the threshold of knowledge on this point. The matter of supreme importance in hypnotism is not the power of another person's will over ours, but the power of our own suggestion and determination over our own unconscious selves. Auto-hypnotism, as it is termed, is by far the most interesting field of research.

It has, perhaps, seldom occurred to those who believe in temperance to ask why it is a virtue. It is not simply abstinence from exciting drinks, but abstinence from undue passions of all sorts that is included in the obligation of a rational man. This evidently is because stimulants and passions excite the mind and lead it to unwholesome power over the body. The result is a taking down of the organism and a distraction of normal functions. The end is a debauched, diseased body, and death. Temperate use of mental functions creates a wholesome body and what we call natural development.

The firm confidence of a patient in his physician, the strong hope of convalescence, will accomplish the chief part in healing and curing. Doctors generally understand this, and desire above all things to win the esteem and confidence of those to whom they minister. To waken an expectation of speedy recovery is over half the battle. Man's imagination, it has been truly said, is not an empty nothing ; nor is it a mere psychical and purely subjective illusion. Every single act of imagination is a real physiological process which can be made available to do a certain amount of work. Ideas as physiological processes is emphasised here, although no folly could be greater than to suppose this power to be unlimited, simply because abstruse. Faith-cure is too generally a delusion, because it is advocated and practised by those who conceive that it is a limitless power. It is helpless over not only broken bones, but over a large part of disease it can be only partially effective. Its main purpose and value is to create a healthy and hopeful will in the place of a chaotic lot of indecisions that often pass for a will. Indeed, nothing is more helpless than the will power of a large part of human beings. Hypnotism is successful in substituting the suggestion of another for the determination of ourselves at times. But there is always great risk in allowing any one to affect substantially our selfhood and to control our individuality.

Extravagant reports of cures effected by hypnotisers are not beyond the suspicion of self-delusion, and can not be accepted without reserve. Most of our hypnotisers suffer from the same disease as their patients, namely, delusions. Other cases are cures only so long as the sustaining imagination can be buoyed up and kept above the disintegrating force of disease. The temporary good is, of course, welcome, but for all that the positive remedy is not in grasp of the will. It may be answered, if only we can make the will or "faith" or imagination strong enough we can conquer absolutely. Ah, well, that is, perhaps, now our problem. But the solution will not come by a course of hygienic lying that compels the victim to say, "I am not sick ; nothing

ails me. I am well. I am sound." Yet this is the stock-in-trade of the professionals too frequently. A course in drugs can do no more harm than a course in falsehood; probably less. Faith-cure, rationally considered, differs from defined hypnotism in this, that the former is the strengthening of self-control, the latter is submission to the control of others. In this view hypnotism involves not only possibilities of greater mysteries, but of greater dangers. It is impossible to measure the possible combinations of individual force, physical or psychical. We fuse with more or less readiness with all persons whom we meet, or else we antagonise. Friendship and love are dangerous in that they involve inevitably more or less of hypnotism. Persons who have been frequently hypnotised lose the power of resistance; exactly so persons who love many and freely lose the power of self-control. That they shall yield virtue is but one step further. The virtue is lost when self-will is enfeebled. Faith-cure, if quite legitimate, and free from fanaticism, enlarges one's power over himself; but that faith-cure which permits the hypnotic manipulations or suggestions of coarse practitioners is a contraction of selfhood.

That field which heretofore has been given over to the imagination, and the phenomena of which have been scouted as incredulous, has suddenly become of vast importance. The power of the imagination is a scientific power. It is a power of our own minds over our own functions and organism, or it is the power of others in the same way exercised. But it will be a great mistake, while considering the more extreme classes of appeal to the imagination, to overlook those more common and therefore more dangerous. Much of the preaching of the earlier part of our century, dealing with the supra and sub-natural elements of hell and paradise, wrought untold mischief. Our dreams were horrid with visions of infernal torture, and our religious emotion was perverted from pure aspirations after virtue and character. Children were subjected to the dynamic pound of terror, and permanently injured as moral beings. Public and collective character was deteriorated. Happily, a more extended knowledge in the present day leads to more wholesome ends.

FACTS ABOUT ALUMINIUM.

The following recently published data on aluminium are of interest: Hoffman, in 1722, announced the theory that alum earth was a distinct base. Marggraff, in 1754, announced definitely his theory of alumina as a distinct substance. Woehler, in 1827, extracted aluminium. Deville, in 1854, extracted the metal at a cost of about £10 for the first half-ounce lump, or at the rate of £537,600 for a net ton. Enlarging his apparatus, he produced aluminium for £20 a pound, or £44,800 a ton; in 1855 and four years later, in 1859, he produced the metal at a cost of 4s. a pound, or £448 a ton. This was not absolutely pure aluminium; as his methods of extraction were such as to leave impurities in his product, and these figures were mainly theoretical, as the cost of the aluminium he really produced was held at 48s. a pound, or £5,376 a ton, from 1862 to 1887. Deville used both chemical and electrical methods. He published his valuable book, "De l'Aluminium," in 1859. Castner was the next producer to reduce the cost. He brought the price down about 20s. a pound in 1888, and later to 12s. a pound. To-day aluminium is advertised at 4s. a pound, for grades not absolutely chemicall[y] pure.

DIRECT CONVERSION OF HEAT INTO ELECTRICITY.

Some Interesting and Practical Experiments.

That electric currents can be developed by the direct application of heat to the junction of two different metals, which is the fundamental principle of the thermopile, was discovered by Seebeck in the year 1823. As regards the theory of the subject, Clausius suggested in 1880 that "by the molecular motion, which is termed heat, electricity is driven from one material to the other;" and Kohlrausch's theory of 1875 is somewhat similar in assuming that the electric current is in some way connected with the flow of heat, and *vice versa*. The discoveries of later years, culminating in the researches of Hertz, prove, however, that the electric current is merely the result of a certain vibratory motion of the luminiferous ether, and, therefore, in accordance with the principles of the conservation of energy, a certain definite quantity of heat can be converted into a certain definite quantity of electricity without either loss or gain of energy, and it is this meaning that is given to the subject of this paper, conversion by a dynamo machine being termed "indirect."

Proceeding then to calculate the absolute efficiency of the ordinary means of producing the electric current by a steam-driven dynamo, the electrical energy developed is shown to be only 6·4 per cent. of the energy existing in the coal burnt in the boiler; but even this low efficiency is eighteen times greater than the direct conversion of heat into electricity as furnished by a Noe and Clamond thermo-battery, where the efficiency works out at only 0·35 per cent. of the mechanical equivalent of the gas burnt. If the high efficiency of the dynamo and the steam engine in themselves, as manufactured at the present day, be considered, it is clear that not much greater results can be expected in that direction, and Herr R. J. Gulcher, of Berlin, has for some years been experimenting in other directions, therefore, for the direct conversion of heat into electricity.

The principal idea acted on at first was the heating of a certain metallic salt in a platinum crucible, which should form the positive pole of the element, and a carbon rod immersed in the molten substance the negative pole; this substance would part with its oxygen to the carbon, and then be reoxidised by contact with the air; and with this form of apparatus, a mixture of caustic soda and carbonate gave an electro-motive force varying between 0·475 and 0·4 volt, the "sodium blast" generated at the carbon point burning at the surface with its characteristic yellow flame, accompanied with slight explosions. For the similar potash salts the electro-motive force was between 0·4 and 0·31 volt, the flame being violet and the burning more violent, and forming a small display of fireworks. The adoption of lead oxide resulted in a momentary high electro-motive force and then a sudden collapse of the platinum crucible, owing to the metallic lead reduced falling to the bottom and eating through the platinum. Herr Gulcher was surprised also to find that at the junction of the platinum connection wire the crucible was also severely pitted, as the current had never been short-circuited, and he has no valid explanation to offer therefor.

After these experiments, the results of which did not promise any simple solution of the problem, the author set himself to improve, if possible, the thermo-battery, and for which purpose attention was directed to the following particulars:—

1. The adoption of durable materials.

2. That the electro-motive force and specific conductivity should be as high as possible.

3. Improvements in the form of the element.

4. Improvements in the application of the heat, *i.e.*, a higher efficiency in the production of the heat itself.

Subsulphide of copper, in spite of its high electro-motive force, gave, on account of high specific resistance, a weaker current than materials which gave only half its electro-motive force, and it was also found that, by a species of dry electrolysis, granules of metallic copper were formed throughout the body of the material, and its use was, therefore, discarded. A form of battery is described, consisting of tubes of nickel and a special antimonial alloy, which was found to be very durable. This consisted of fifty elements in series united in one casing, and gave an electro-motive force of 3·5 volts, and an internal resistance, when hot, of 0·4 ohm, with a consumption of 7½ cubic feet of gas per hour, and the absolute efficiency is 1·08 per cent. or three times that of the existing thermo-batteries. Such a battery is almost exactly equivalent to two Bunsen elements, and though it is far below the dynamo in efficiency, still it may be suitable for various small installations and for experimental work, owing to complete absence of polarisation, as the electro-motive force does not fall on short circuit. The durability is enhanced by a regulator applied to the gas supply to prevent any accidental overheating.

The author concludes by stating that he hopes to produce cells which are the outcome of still later researches, and in which the efficiency has been raised to over 5 per cent., and thus almost capable of competing with the dynamo. The description of the construction is withheld; but it is stated that one form is capable of continuously furnishing current for eight 16 candle-power lamps at a consumption of 4·5 lbs. of coke per hour. This success the author hopes still further to advance, and thereby exceed the efficiency of the dynamo system as a converter of heat into electrical energy.

ANSWERS TO CORRESPONDENTS.

F. W. Willson.—The manufacture of artificial eggs was dealt with in Nos. 6 and 9 of Science Siftings, pp. 83 and 130.

Zummerzet.—We note all you say, and thank you for friendly remarks and suggestions. Our present contracts will prevent our making the proposed alteration for about three months, but after that period we shall doubtless be able to satisfy both advertisers and readers.

Naturalist.—Thanks very much, but hardly popular enough for our purpose.

L. Pearson.—Any text book on photography will give you the desired information. Yes, bichloride of mercury is a poison.

G. Attewell.—He was not the inventor, but he first succeeded in achromatising it.

T. R. Kenny.—We have placed no limit upon the number of words permissible for our "Science Queries and Answers" column; but, other conditions being equal, preference will be given to those that are concise.

Arthur James.—Darwin's theory certainly evolves man from the ape. The missing link has yet, however, to be found. Read "The Descent of Man" by this author.

F. Doble.—We have fully expressed our opinion on the "rain-making" experiments, and it is not worth while referring to them again, except to mention that some attempts recently made in India have proved only an equivocal success. See our paragraphs in another column.

Aeronaut.—Yes; the fire, or hot air, balloon anteceded those inflated by hydrogen and coal gas. The Balloon Society does not confine itself to aeronautics. In fact that subject is very seldom dealt with at its meetings.

Glasgow.—The notice was amended because we found that we could not get the paper to press at the proper time unless it was done. We were late in publishing this week, owing to the fact that we were compelled by our notice not to close our pages until Monday. See our fresh notice.

WHAT IS BEAUTY?

Man has, from time immemorial, so raved about beauty in women, and poets in rhyme and romances have sung its praises, that it would be natural to conclude that physical beauty is the only beauty lovable in the sex. And the proverb, "Men lose their hearts through their eyes, and women through their ears," not only corroborates the idea, but makes it appear that, in our sex the senses and in the opposite sex the intellects predominate. Men are sensuous enough and set sufficient store upon physical comeliness in woman. But, after all, it appeals to them as an effect rather than a cause, and is outweighed by a dozen other qualities. Beauty commends, but it does not win; it attracts, but it does not hold. And, if it be not answered by some inward beauty, it soon disappoints; and may, by constant suggestion of disharmony, at last repel. Just as a fair flower invites us. We admire its form, its colour, its daintiness. But when we pluck it and find it scentless, a reaction comes that borders on disgust. We feel we have been cheated by a counterfeit, and the flower looks homelier than if it were less fair.

So there must be something more—a vast deal more—than personal beauty in woman to make her, for any length of time, even pleasant in our eyes, much less grateful to the heart. What that something is it is difficult to say; but it is expressed in the word "interest"—which, to convey the exact idea, should be "interestingness." How or why any one interests us we can not determine. Of the fact we are convinced beyond argument, but we are incapable of analysing the subtle agencies that produce the effect. This capacity to interest is not a necessary concomitant of personal comeliness, but, on the contrary, is generally independent of it—at least, is so strong and subduing an influence that mere form of feature becomes either secondary or is lost sight of altogether.

No doubt such a thing as interest, and of a general kind, belongs to individuals as it does to books—is as much a part of them as amiability, courtesy, or ease of motion. Certain men and women, without effort, without desire, or even without consciousness, almost universally attract others. Wherever they go their triumphs follow them. To be near, is to be drawn to them. To know, is to love them. We have all of us met such persons. We can think of half-a-dozen, at least, of our acquaintances who interest nearly every one they meet, regardless of sex. This is particularly true of certain women; and yet how few of such are beautiful, or handsome, or even pretty, in the usually received sense?

Nature, to her sons and daughters, is a trifle niggardly, save when she seeks to show—as in her Crichtons and Abelards and Mirandolas—the splendour of her bounty; being unwilling to give two great gifts to the same creature. When she grants physical beauty, the mind accompanying it is apt to be inferior. Geniuses are seldom beauties, and beauties seldom geniuses. It happens, too, that women of fine persons come to prize their comeliness so much as to neglect their mind, and, not unfrequently, their manners—permitting a naturally good understanding to go to waste for lack of common care and culture. Hence it is that the very pretty women of society whom men optically admire, and of whom we hear so much, rarely excite any profound emotion or win the hearts of strong or positive men. They carry in their train many followers of fashion, are looked at and lauded as a curious pattern of furniture would be in the drawing-room. But no one loves them. No divine fire is burned on their altars. No elements of high poetry or

grand tragedy are enlisted in their lives. They dwell in an atmosphere of flattery and folly, are haunted by coxcombs and wedded to fools.

The women who make deep impressions—who carry with them an atmosphere of their own—who make social listeners for themselves—and would make revolutions, if the times were fitting, bear no badge of beauty as an emblem of their power. Their forces and fascinations are invisible to the eye. Their mind, their manners, their sympathies, their instincts, their spiritual insight—something of all these fix, mould, and sway the natures of others, and make or unmake fortunes and careers. They are the women who convert sensualists into saints, warriors into Sybarites, gallants into heroes, poets into swine. Their power for good or evil is unmeasured, and circumstance determines which it shall be. Strong men bend, icy hearts take fire, breasts of adamant melt before them; and yet no outward shape of beauty assists at the spiritual conjuring. They work their miracles as mysteriously to themselves, peradventure as to others; but sensuous seeming has no part in the mystic rites.

Those are the Cleopatra women—as they might be called—who are ever setting mankind by the ears, and making the elements of tragedy wherever they smile or kiss. Semiramis and Sappho were, without beauty, creatures of terrible power—fierce in their passions as tigers, and fascinating as serpents.

Cleopatra, it is well known now, was not lovable in person. Red-haired, thick-lipped, flat-nosed, masculine in her proportions, she converted the brave and gifted Antony into a tipsy driveller, and caused the great Julius to forget his absorbing ambition in her love. Lying drunk with voluptuousness at her royal feet, fondling her fragrant hair, he heard without heeding the call of his invincible legions, and all the glorious memory of Rome and empire was drowned in Cleopatra's soft caress.

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SCIENCE NEWS AND NOTES.

"We consider it tedious to talk of the weather, and yet there is nothing more important."—AUERBACH.

Sold Out Again !

THE circulation of SCIENCE SIFTINGS has been advancing by leaps and bounds, and our last issue was sold out on the day of publication. Many would-be purchasers had to leave the publishing offices empty handed, much to our and their regret. In order to prevent the recurrence of this accident, and to prevent any disappointment whatsoever, we trust our readers will place their orders a little earlier than hitherto with their newsagents, so that we may be better able to gauge the demand.

The Influenza Epidemic

is, we believe, now happily on the wane, and those who were frightening themselves into the dread complaint may now take heart again and by the same will process convince themselves that they are in the best of health. A great deal that is not influenza has been mistaken for it, and many who have only had the misfortune to contract an ordinary cold have coddled themselves for *la grippe*. Influenza proper means a veritable fever, marked, as Dr. Andrew Wilson defines it, by certain fairly specific and constant symptoms. There is the sudden onset, though doubtless the germ has been incubating in our bodies for its own period ; there is the usual temperature marking the fever ; there is the severe headache, showing a disposition on the part of the ailment to affect the nerve centres specially ; and last, though by no means least, there is the pain in joints and muscles, assimilating influenza to certain affections of malarial type, and specially to the "break-bone" fever of tropical fame. One curious feature about the ailment is its widely different course in different persons. The "personal equation," so to speak, of a patient seems to have much to do with the course and order of the symptoms—more so than in most other ailments. In one person the headache is worst, in another the joint pains ; one person has a tedious convalescence, and struggles back to health only after months of general weakness ; his neighbour has a short and sharp attack, and gets well quickly.

The Cause of Influenza

is the scientific problem of the day. The strange part about it is that it is not a new complaint as many suppose. The report on the Influenza Epidemic of 1889-90, by Dr. Parsons, tells us we can go back to 877 for the first sign of the epidemic, and it appears to have prevailed at irregular intervals ever since. It has, therefore, been with us for centuries, and yet we know little more about it than did our ancestors. Of course, there is a bacillus in it. There is no complaint nowadays without one. It has been discovered by Drs. Pfeiffer and Canon, of Berlin. Dr. Koch, of bacillus fame, commissioned these gentlemen to search for the influenza bacillus, and they began by examining the sputum of patients, which was found to have a peculiar character. They purified the discharge by the Koch method, being thereby enabled to discover the bacillus. A peculiarity of the influenza bacillus is said to be its immobility. It is found in various positions—singly, in chains, and in strings. The chief characteristic, however, is the size of the microbe. The influenza bacillus is the smallest yet discovered. It is only half as large as the bacillus found in cases of blood poisoning, the bacteria hitherto regarded as the most microscopic organism existing. The new bacillus resembles most closely that present in cases of inflammation of the lungs—the Friedlander bacillus, so called from the name of its discoverer. It differs from it, however, in its shape, which is oval, and not round like the latter. It may be mentioned, however, that Dr. Jölles, of Vienna, also claimed to have discovered the microbe in 1890.

The Treatment of Influenza

is the subject of more diversity of opinion among medical and lay men than any other similar topic. It has been said that abstainers from butter suffer complete immunity. This we cannot credit, for the nourishment contained in butter is very great, and it is only by keeping the system well up to a healthy standard that we can hope to resist the attack. However, there is, of course, the possibility that the microbe may be transmitted through the butter from the animal whence the milk comes. Others make the suppositious preventative qualities of whisky and port wine an excuse for imbibing these liquors at all hours. We are not teetotalers, but such a course is eminently of the "rushing into the lion's jaw" order. Temperance in all things and recourse to suitable doses of quinine or some other tonic are the best preventatives we know. When once the complaint is contracted, we agree with Dr. Wilson that the only safety for a person seized is to confine himself at once to his bedroom, to go to bed, to maintain an equable

temperature, and to send for his physician. No sensible layman, save anyone far removed from medical aid, will attempt to physic himself. Once seized, the doctor's attention is our safety, and more especially because, as we have of late unfortunately seen, the presence of *la grippe* lays us singularly open to be attacked by lung complications, whereof pneumonia, pleurisy, and the like are but too familiar examples.

The Deadly Cold Bed,

whether it be damp or merely cold, is claimed to be the cause of an appalling amount of permanent disease and death. It is a peril that constantly besets travellers, and if they are wise they will invariably insist on having their beds aired and dried, even at the risk of causing much trouble to their landlords. But it is a peril that resides also in the home, and the cold "spare room" has slain its thousands of hapless guests, and will go on with its slaughter till people learn wisdom. Not only the guest, but the family often suffers the penalty of sleeping in cold rooms and chilling their bodies, at a time when they need all their bodily heat, by getting between cold sheets. Even in warm summer weather a cold damp bed will get in its deadly work. It is a needless peril, and the neglect to provide dry rooms and beds has in it the elements of murder and suicide.

Excessive Meat Diet

has just received the unqualified censure of certain French physicians, and the attention of the French Society for the Advancement of Science has been directed to the evil effects of an immoderate meat diet, or of raw, overkept, or bad meat. It is asserted by these gentlemen that the ptomaines thus produced introduce poisonous principles in the system, which the kidneys cannot throw off. Inhabitants of cities, they say, indulge far too freely in meat, often badly cooked and kept too long; the poor and country population do not often get their meat fresh. Prof. Verneuil considers something should be done to remedy this state of things. He points out that Reclus, the French geographer, has proved that cancer is most frequent among those branches of the human race where carnivorous habits prevail. This statement is, we believe, only conjectural. English medical men are almost universally coming to the conclusion that a meat diet is specially suited to the human constitution. This is always with the proviso that plenty of hot or even cold water be taken to wash away the waste products from the cells of which our organs are composed. Except in specified complaints, however, a certain quantity of vegetable matter combined with the meat diet, will form the best all-round regimen.

Blushing

is a serious inconvenience from which a correspondent who asks for the cause and remedy suffers. We know of two kinds of blushes, the one inspired by shame and the other by modesty. Of course, diffidence and surprise may also cause the cheeks to be diffnsed. We do not know the origin of our correspondent's complaint, but the origin should suggest the cure. Physical weakness, the result of fast living, will often bring about the condition so much objected to. It is supposed to be produced by a kind of sympathy between several parts of the body, occasioned by the same nerve being extended to them all. Thus the fifth pair of nerves being branched from the brain to the eye, ear, muscles of the lips, cheek, palate, tongue, and nose, a thing seen or heard that is shameful covers the cheeks with blushes, driving the blood into the minute vessels there dispersed, and also affecting the eye and ear in a similar manner. For the same reason it is that a savoury thing seen or smelled affects the glands and parts of the mouth; that if anything pleasing be heard, it affects the muscles of the face with laughter; and that if it be melancholy, it affects the glands of the eyes and occasions weeping.

To Prevent Coal Dust Explosions

a new device has been successfully tried in Germany. The usual method of sprinkling water in dusty parts of the mine has only a limited valne, as the dust is generated by the breaking down of the coal, and explosions may occur from the liberation of gases at the same instant. To meet such cases, the use of water has been given an entirely new application, the effect of which was somewhat a surprise at the first experiment. Holes 1 metre deep are drilled at a distance from each other of about three metres, wooden plugs are inserted, and through them iron pipes from three-quarters to one metre long, with opening between $2\frac{1}{2}$ and 3 millimetres large, and connected with a rubber hose. In the Camphausen colliery a pressure of from eight to ten atmospheres and injection through two tubes in eight hours proved sufficient to impregnate $6 \times 1 \times 1\frac{1}{2}$ metres. In the Kreuzgraben colliery the water forced in under a pressure of twenty atmospheres during 16 hours moistened thoroughly the coal as far as 4 metres above the highest hole. Of importance for the successful application of this method are the water pressure obtainable, the quantity of water injected, and the firmness of the seam, the last item depending to some extent on the size of the coal pillars in the workings.

Meteorological Observations During Balloon Voyages

formed the subject of a lecture by Dr. Assmann at a recent meeting of the Berlin Meteorological Society. For the determination of temperature, humidity, and atmospheric pressure in a free balloon, the aspiration thermometer and an aneroid barometer suffice. Comparative measurements made by Rotch, in Paris and Berlin, during balloon voyages, showed that a Richard's thermograph records a temperature some 8° C. higher than does a maximum and minimum thermometer, and the latter shows a temperature always 2° C. higher than does an aspiration thermometer. In order to carry out prolonged observations on humidity during a balloon trip, three aspiration thermometers must be combined, of which two are alternately moistened while the third is kept dry. For use in captive balloons self-registering instruments must be employed, whose construction, owing to the frequently violent vertical jolts of the balloon, presents considerable difficulty. Dr. Assmann exhibited tracings which showed that these difficulties had been overcome by him. Temperature is recorded by a bent Bourdon tube filled with alcohol, humidity by a hair hygrometer, and atmospheric pressure by an aneroid; all these instruments being placed in a space in which aspiration is continuously kept up. Each instrument records upon a cylinder which rotates once in about five hours. The German Ballooning Society proposes to make simultaneous observations in a free balloon, and with a self-recording apparatus suspended by a long cable from the car of the balloon.

An Amphibious Steamer

has just been finished in Sweden and has done its first trial trip. There seems to be no reason why it may not be a successful traveller on land as well as water. Near Boras, in Sweden, there are two lakes which are separated by a considerable strip of land. The object of the strange steamer is to save expense in the transportation of freight across the

lake, particularly the avoidance of double shipment. Rails have been laid across the land slip, and the steamer is so constructed that by its own engine it can be run from the water upon the rails and then roll across until it dips into the other lake. The little steamer is of ten horse-power, and can accommodate 90 passengers in addition to its freight. It is very appropriately named the "Svanen," which is Swedish for swan.

To Prevent Pipes Bursting

in frosty weather, an ingenious but simple method has just been devised. It consists in attaching a cup-shaped air chamber to a piece of pipe, which can be coupled at both ends with the pipe to be protected. The air chamber is separated from the water flowing through the pipes by means of a rubber diaphragm. In case the water in the pipe freezes, the expansion of the water, instead of finding an outlet by bursting the pipe, simply forces the diaphragm to yield, thus compressing the air cushion within the cup. It is said that a pipe so protected will have entire immunity from bursting by frost.

"Insanity and Genius"

is the title of a book by Prof. Lombroso. It is a work in which the author claims that genius is the evidence of a degenerative taint, and is, in fact, an "epileptoid degenerative psychosis." We trust that our readers will not be made to feel a sense of apprehension concerning their own mental soundness by Professor Lombroso's thesis. It is one that has been worked at before by Moreau de Tours and a good many others, and neither the world in general nor the medical profession in particular has been seriously impressed by it. Men of genius have not, as a rule, been mad, except with an insanity of a scientific and scholastic kind, such as the world really needs more of. The eccentricities, monomanias, and emotional exaltations of genius have been incidental, and were not the basis of their character and temperament. Insanity is essentially a non-productive condition. No insane man has ever made a great discovery and originated great thoughts, or, by his own laborious efforts, changed the tide of human events. Insanity is a condition in which the power of adjusting one's self and one's conduct to the environment is lost. Surely there is no loss of this kind shown in the work or conduct of men of genius. Contemporaneous science has dealt somewhat kindly with Lombroso for the valuable work he has done and the new fields of study he has opened. But the *Medical Record* thinks that when he makes out Newton and Luther insane, and Christ a paranoiac, one must think that the professor himself has neither sanity nor genius.

When the Spots on the Sun

are at a maximum the number of "magnetic storms," or disturbance of the earth's magnetism, as well as of "earth currents" of electricity and displays of the aurora borealis, are also at a maximum. Thus in 1870-2, and 1881-3 we had maxima of solar spots, magnetic disturbances, and auroras. The interval between two periods of maxima is about eleven years, and hence we are, says the *Globe*, approaching another period. We may expect, our contemporary thinks, to see unusual displays of the aurora, either during the remains of the present winter or during the next and the one after. Indeed, a fine display was observed not many days ago at Driffield, in East Yorkshire. It showed an auroral arch or bow, white inside and red outside, apparently resting on a bank of dark cloud. Mr. Veeder, an enthusiastic observer of auroras, has prepared blank forms for local observers to fill up, as a good deal may be done by co-operation to discover the mystery of the aurora, and the true secret of its connection with solar spots. Amateurs should note the state of the weather before, during, and after a display, more especially the changes of the wind, as some think that the electricity producing the display is generated by the collision and commingling of cold and dry and warm and moist air. The appearance and behaviour of cirrus clouds, if any are present, should also be watched. It should be observed whether the dark segment under the bow shows the stars through it, or takes the form of a cloud. The position and features of the aurora during its whole development are to be carefully recorded, not only with respect to the horizon, but the zenith. The spectrum of the light is, of course, important; but photographs cannot be taken of the display.

The Light of the Aurora,

though sometimes bright enough to enable one to read small print, and to paint a picture of the arch, as was done by Herr Carl Boch in Lapland, is ineffectual in photography. One Scandinavian meteorologist, after many fruitless attempts with very sensitive plates, did succeed in getting a faint impression of luminosity, but that was all. Whether or not there is a noise accompanying the aurora is still a moot point, but on the whole the evidence is in favour of the "hissin' eerie din," as described by Burns. The existence of a sulphury odour accompanying the display is more doubtful, bnt it may have been observed in the case of auroras very near the ground, and might be due to ozone and other gases developed by the electric discharge. The arch aurora is the commonest type, and it occasionally takes the form of a snake or serpentine light, such as was seen by Mr. Frederick Whymper, the artist, while in Alaska. The "curtain aurora," which resembles a vallance or hanging drapery of prismatic light, is rarer still, and very beautiful. The grandest form of all is the pavilion aurora, produced by the curtain aurora extending over the whole sky, like a a conical tent of light above the spectator. A writer in the *Globe* points out that it is occasionally seen in Scotland and the north of Europe, and is said to show in perfection in Eastern Siberia, where the auroras are frequently magnificent. George Kennan, in his "Tent Life in Siberia," gives a long description of one he saw there; but pen and pencil equally fail to do justice to a really fine display.

The Melting of Snow,

as we mentioned in the first issue of SCIENCE SIFTINGS, is a problem that Edison has set himself to solve by means of electricity. That he will accomplish it goes without saying. Everything he sets his mind to do he does, but our attention is now drawn by Mr. Thomas Fletcher, F.C.S., to the fact that there has been, this winter, the usual crop of inventors who, without the slightest knowledge of the subject they advocate, endeavour to enlist the time and money of others, as ignorant as themselves, in a very foolish scheme, *i.e.*, to use ordinary gas to melt the snow which obstructs the streets. Some of the sanguine have gone to some expense in demonstrating what was already known, *i.e.*, the possibility of it irrespective of cost. How absurd such a project is can be easily seen by comparing the known heating value of coal gas with the work to be done. Six inches deep of average snow, when melted, becomes half an inch depth of water, 24 square feet of which will weigh 62½ lbs., or 23·4 lbs. per square yard. At this rate the snow on one mile (or 1,760 yards) of a street 20 yards wide would, if 6 inches deep,

weigh 823,680 lbs. or 363¼ tons. The heating power of London gas is 660 units per cubic foot, *i.e.*, one cubic foot of gas will heat 660 lbs. of water 1° F., and of this we may take it as a maximum that 500 units could be utilised. It has been proved repeatedly and beyond question that 1 lb. of snow at freezing point requires 150 units of heat to melt it and raise the temperature of the water obtained to 40° F., and this effect would be produced on 3⅓ lbs. of snow by the consumption of one cubic foot of coal gas. From the above data it will be found that to melt the snow in the assumed mile of street would require the consumption of 247,000 cubic feet of gas, costing, at 3s. per 1,000 cubic feet, a little over £37, or at the rate of £3,256 per square mile. As there are a great many square miles of streets in many towns, and as the snowfall has already been nearly double that assumed, it will be seen that the problem is, most certainly, not one to be solved by this method. Even if we were to assume that the cost of gas and labour were not prohibitive, the fact that the ground itself is usually colder than 32° must be considered, and the ground would also have to be warmed, or a thin surface of glassy ice, of the most slippery and dangerous kind, would remain after the snow was removed ; this alone would condemn the project as being unworthy of consideration.

How Clouds Float

has been a matter for considerable research with Herr von Frank, of Groy. Minute particles of watery vapour form a cloud, but water, no matter how light, must come under the influence of the attraction of gravity. Yet clouds seem to drift about or hang suspended without being subject to any such law. Herr von Frank explains this anomaly by the presence of a minute envelope of vapour around each floating particle, the lengthening of the shadows of objects when clouds pass over the sun being attributed to refraction by the vapour envelopes. This vapour envelope, he tells us, is a bad conductor ; hence it guards to some extent the droplets from evaporating and freezing. Heat expands the envelope surrounding these little spheres, so that they ascend, a phenomenon seen in the rise of mist in Alpine valleys. A still more remarkable phenomenon is explained by the existence of these vapourous envelopes. For instance, liquid droplets have been observed floating in air of 14° (18° below the freezing point), and where they met a solid body froze to a lump without crystalline structure. This was due to the vapour envelopes being ruptured by collision with the solid, the droplets thus losing the bad conductor of heat which protected them and solidifying so quickly that no crystals could form. Herr von Gray believes that with much aqueous vapour in the air larger drops form, the clouds in that case floating lower. With less vapour the drops are smaller and the clouds higher, the thickness of the envelope being, however, the same for large and small drops under like conconditions of temperature and pressure. It is temperature, therefore, according to this theory, that explains the flotation of clouds.

Travelling is to be Revolutionised

by a young American, who intends running an ordinary car at the expense of thirty pounds of petroleum a day. His idea is a caloric engine. Into a powerful reservoir, which combines the functions of boiler and furnace in one, is introduced kerosene in jets. It is ignited here, and forms the usual products of combustion, chief of which are carbonic acid gas and water. Water is also introduced in fine spray from another channel and instantly converted by the heat from the burning oil into steam. The jet of mingled gas and steam is forced through a cylinder into a vessel containing glycerine. The gas, glycerine, and steam are thoroughly mingled, and then forced upon a sort of double turbine wheel, which revolves with great force and makes the thing go. At least, its inventor says it will go. If it will, a vast amount of trouble, coal, smoke, soot, dead weight, perspiring labour, and tons of ashes, furnaces, boilers, etc., will be obviated.

The Progress in Machinery Construction

has been so rapid in recent years that few have any true conception of its extent. The difficulties which were met with sixty or seventy years ago in making suitable tools and machinery from metal were innumerable. There were no planing, boring, or shaping machines ; the turning lathe and the drill-borer were about all the devices that could be called into use by the mechanic of that time. Sewing machines, which play such a part in the manufacture of boots and shoes, could not possibly be made at that time. All inventors had to make by hand the machines they invented, without the aid of other machines in the making of the individual parts. They had to invent some tools so as to be able to make certain parts of the invented machine. When the celebrated machinist, Clement, entered a shop as master in 1814, he found the tools so poor and defective that he had to spend days in making such tools as were needed. James Watt, the inventor of the steam engine, could not get his first machines in working order in consequence of lack of some contrivances. The first cylinder, which he had cast was not tight, and was on one end five millimetres wider than on the other. A good cylinder should not show more difference in width than one-half millimetre ; and then the cost of work at that time was extravagant. The polishing of cast iron cost 12s. per square foot forty years ago, as the work had to be done by hand. To-day a metal planing machine does better work for a penny.

The First Steel Pens

had to be made by hand. The manufacturer, Perry, paid for the first lot 5s. a piece, and we often read that steel pens used to cost a guniea. But still these pens were not as good in quality as those which are made to-day. After factories had been established, the price of a steel pen was still 4s., then 2s., and finally 1s., which price was kept up for some time. To-day we are able to obtain a gross for that price.

Death Valley

is a most wonderful depression in the southern desert of California, N. America, lying 175 feet below the level of the sea. We recently had the pleasure of publishing a report by Mr. Mc.Gillivray, lately returned from the spot. Another prospector, Col. T. W. Brooks, of Pomona, U.S.A., has just been to the same region. He travelled over 800 miles alone. He says the mineral resources of the country are alone enough to warrant the building of the proposed railroad from Salt Lake to Los Angeles. He gives details of veins and deposits of silver opened up by Salt Lake and other mines which alone would almost furnish enough traffic for a road, but at present the ores cannot be profitably handled. Being alone, with the care of a team in a country inhabited only by a few wild beasts, lizards, and stray birds, he did not do much practical prospecting, but he saw enough to convince him that that apparently worthless and very forbidding country is of immense value, and that the wild beasts, birds, and reptiles will not have exclusive possession much longer,

SCIENCE QUERIES AND ANSWERS.

A prize of two shillings and sixpence will be awarded for every interesting question asked by our readers and published in this column and five shillings will be given for every answer published. In all cases when a similar question or reply is sent in by two or more correspondents, the award will be given to the one whose letter is first opened, provided the subject is properly treated. Questions asked by correspondents and not replied to by our readers, may, if of sufficient interest, be dealt with Editorially.

Rules for Competitors.—(1) Only one question may be sent each week, but any number may be answered. (2) Write on one side of the paper only. (3) Envelopes must be marked "Science Queries and Answers," and must arrive not later than the Monday following date of publication.

QUERIES.

Answers to the Queries published last week will appear in our next issue.

Answers to the following Queries will appear in the issue after next.

19.—Can messages be transmitted along a telegraph wire without affecting the simultaneous passage of electric currents through it?

20.—I have lithographs or engravings on paper that is printed on the back. Can I transfer or prepare them for exhibition by the optical lantern?

21.—It was recently proposed by an American to make "air ships" of a thin steel shell, exhausted internally. Is the scheme practicable, and would it present any advantage over the ordinary hydrogen gas balloon?

22.—Can the interior of an animal's body be illuminated by means of the small electric lamps, sold as "fairy lamps"?

23.—Does science offer any prospect of cure for persons afflicted with total and congenital deafness?

24.—What is the simplest and cheapest method of constructing a luminous water cascade for exhibition by a small magic lantern?

"SCIENCE SIFTINGS" SALE AND EXCHANGE COLUMN.

In deference to the wishes of a very large section of our readers, we have decided to open a Sale and Exchange Column under the following rules:—

Tariff: *First 20 words or less 6d. Every additional 3 words 1d. If replies are to be addressed to the office of* Science Siftings, *a charge of 3d. will be made for booking and forwarding replies.*

Deposit System: *To facilitate the transaction of sales between strangers, the purchase money may be deposited with us. We will acknowledge the receipt of the deposit to both parties and hold the money until we are satisfied that the goods have been returned or the purchase satisfactorily concluded. When remitting to the Seller or returning the deposit (if no sale be effected) the following amounts, to cover expenses, will be deducted:—*

For amounts under 40s., 6d.
,, over ,, 1s.

In the event of articles sent on approval not being returned, or notice being given to us within 4 days, the sale will be considered effected, and the purchase money forwarded to the vendor.

Exchanges: *We cannot undertake to receive or forward articles; money, therefore, to the estimated value of the exchanges should be deposited with us.*

Remittances, etc.: *All remittances must be made either by postal order or half-penny stamps. Envelopes must be marked "Sale and Exchange," and addressed to the Manager,* Science Siftings, *78, Fleet Street, London, E.C.*

GLEANINGS OF THE GLOBE.

Rome is now lit by electricity.

People in the Arctic regions can converse more than a mile apart.

A flock of migrating pigeons in North America has been calculated to include 2,230,000,000 individuals.

The family of palms contains upwards of a thousand species, some of large size forming extensive forests.

The Prince of Monaco is engaged among other submarine experiments in testing the temperature of the sea at varying depths.

Nutmeg *(myrstica moschata)* grows naturally in several islands of the Eastern Archipelago, but is principally cultivated in the Banda Isles.

Some eminent breeders, during a single lifetime, have so largely modified some of the higher animals, that they have practically formed a new sub-breed.

There is a race of shepherds at the village of Gomern, in the peak of Teneriffe, who are able to converse at a distance of two or three miles by intelligible whistling.

"Luminous and Non-Luminous Combustion," by B. H, Thwaite, C.E., of Liverpool, is a most interesting pamphlet, dealing in a clear and concise fashion with the subject set forth in its title.

Cliffs are only worn away by the tide when the sea is charged with pebble and sand. Darwin says there is good evidence that pure water effects nothing in wearing away rock.

There are no less than twenty-eight bones in one hand and wrist, and about as many in a foot and an ankle. The bones of the hand and feet are equal in number to one half of all the bones in the human body.

Meteoric stones seem to fall more often in March, May, July, and November than in any other months, and, comparing the first six months of the year with the last six, they are more numerous in the latter period.

Shooting stars are rendered visible to us by being inflamed by the friction resulting from contact with our atmosphere, into which they rush with immense velocity, becoming thereupon consumed instantly, and reduced to imperceptible dust.

It was long thought that shooting stars were merely incandescent objects of atmospheric origin, but this theory is quite exploded, and it is now agreed that they are of celestial origin, pursuing objects similar to the orbits of comets, and grouped into streams containing myriads upon myriads of detached particles.

Why trees or other plants grow erect has never yet been definitely determined. It has been supposed to have some relation to the action of light. Certainly, a plant usually growing erect turns toward any opening for light in a dark cellar, but when there is no light they grow erect. Dr.

Maxwell S. Masters has recently called attention to some cases in an English coal mine 1,000 feet deep. Some props made from green posts pushed into growth, and though in absolute darkness they were perfectly erect. They were perfectly blanched.

When meteoric stones fall in numbers, the curious and unexplained fact has been noticed that the area over which they fall is generally an oval from six to ten miles in length by two or three miles in breadth, and that the largest stones may be looked for at one extremity of this oval.

Fire-balls are intermediate in character between meteoric stones and shooting stars. They appear in the sky suddenly, and very often take a pear-shaped form. Usually they are noiseless, but sometimes an explosion accompanies their appearance, and in this latter case, very likely a fall of meteoric stones is the result.

As showing the tardiness of birds in acquiring a dread of man, the late Charles Darwin in the account of some of his travels, stated that a gun was almost superfluous in the unfrequented districts of South America, for with its muzzle he actually on one occasion pushed a hawk off the branch of a tree.

A million years is a trifle to geologists, but few of us know what a million really is. Mr. Croll gives the following illustration:—Take a narrow strip of paper, eighty-three feet four inches in length, and stretch it along the wall of a large hall; then mark off at one end the tenth of an inch. This tenth of an inch will represent one hundred years, and the entire strip a million years.

Some plants occur in a single specific locality, frequently a contracted area, and nowhere else. The beautiful *disa grandiflora* is limited to a spot on the top of the Table Mountain at the Cape; and the celebrated cedar of Lebanon appears to be restricted in its spontaneous growth to the Syrian Mountains. The small island of St. Helena has an indigenous flora, with a few exceptions different from that of the rest of the globe.

A correspondent commenting upon sciatica, says that if the positive pole of a galvanic battery, having the pole (carbon preferred) covered with absorbent cotton and moistened with chloroform, be put over the painful parts, and five to ten milliamperes of current passed through it, using every other day for a short time, a cure will be effected, providing there is no constitutional trouble. The negative pole can be applied at any suitable place.

No war-ship with any pretension of modern equipment is without an electric plant. The heavy guns, which heretofore required the services of several lusty men to point, are now moved by an electric motor. The gun captain can himself, by moving a small lever located at the back of the gun, point it in any direction desired. The advantage gained is not so much in the fact that the gun can be moved quickly as that it is under the control of one mind. Complexity is giving way to simplicity, and in order to have every part of the ship do its work at the proper instant the captain, ensconced in the conning tower, can place himself in communication with any part of the vessel by means of the telephone.

THE VALUE OF SCIENTIFIC KNOWLEDGE.

The value of scientific knowledge, we are told, lies chiefly in the improvement of the man himself who possesses it, in the sharpening and strengthening of his faculties, in the formation of just habits of thought, and in the aptitude which it communicates of dealing with unforeseen circumstances as they arise. It does not teach him to do anything which men of practical experience only cannot do; but it teaches him to do many things in the right manner, and at the right time, which *they* might not think of doing at all. A man familiar with the ordinary phenomena of chemistry, and well instructed in the laws of that science, would be so much better qualified to deal with ventilation than if he knew nothing of the composition of the atmosphere, and this for the simple reason that he would more readily and keenly appreciate the importance of an abundant supply of fresh air. It is quite true he could do nothing extraordinary towards averting an outburst of gas, or neutralising the disastrous effects of an explosion; but, in proportion as he understood the danger, he would be the more vigilant in adopting the necessary means for guarding against it. Coal-mines are infested with other gases besides carburetted hydrogen, and it is of great importance to the health of the workmen that they should be cleared away as fast as they are discharged. The man of scientific knowledge, though possesscssed of no specific, nor master of any conjuring process for expelling them, is yet better qualified than an ignorant man for dealing with them, because he understands not only their nature when he encounters them, but also their injurious influence on the health and spirits of the workpeople.

A scientific knowledge of mechanics is useful to many classes of officials employed in connection with mines, not because it lets them into any secrets for doing work more economically or more expeditiously than ordinary workmen can do it, but because it opens their eyes so that they can see when work wants doing, and awakens their faculties to the right time and the right mode of doing it.

In an extensive and well-organised system of industry, whether in a cotton mill, a mine, or elsewhere, the greater part of the people employed are restricted to one simple and monotonous duty, in the performance of which scientific knowledge can render them little assistance. Yet even in the superintendence of a machine, there is a difference between intelligence and stupidity, which is to the advantage of the former. In the case of officials invested with authority or intrusted with discretionary powers, a man with a little mental cultivation can discharge his duties much more to the satisfaction both of his employer and his fellow-workmen, than will one whose faculties have never travelled beyond the limited sphere of his own observation.

In few departments of industry have there been of late years so many and such signal improvements as in that of mining, and all these improvements have been framed more or less closely in conformity with scientific principles. It is true that many of them have been introduced by shrewd practical men, with no guide but their own sagacity, assisted by experience; but it is equally true that such men have previously spent an infinity of labour to little purpose, which labour they might have spared themselves had they possessed a little scientific knowledge, and thereby become acquainted with what others had done before them.

Few of our readers will have much difficulty in calling to mind cases where men have raised themselves to respectability and competency, and opened out the means of livelihood to hundreds of people around them, through their

knowledge of science in general, as applied to the various industries, and to their knowledge of geology, in particular, as applied to their various departments of mining.

But why give further reference to this matter, which has been under consideration for the last fifty years, or ever since the first Mechanical Institute was established, to collect and disseminate industrial knowledge among both employers and employed? The establishment of technical schools was the means by which Europe took, and has kept the advance step, in the industries up to the present time. It has been by means of these schools that the managers in our mines and our shops have led the world of industry.

The best test of theory is to be found in results, and we believe that whether in mine, the shop, or the field, those countries and those districts, where most is done for the promotion of education among the masses, have become the most prosperous communities. It is there that the workmen get the highest wages, and the employers universally realise proportionate profits. Of course these observations, like all others comparing the results of knowledge with those from ignorance, is based on the assumption that in all other important points the cases are equal. No superiority of knowledge or management will make a poor mine a rich one, but it will, in every case make a poor mine pay better than though it were worked under ignorant or vicious management. Of course, no education will make a blockhead as capable as a man naturally endowed with a quick apprehension and sound judgment. All we claim is that a man with length and breadth of experience, supplemented with a thorough scientific education, will make himself more useful in any calling, than a man with any amount of experience, but totally deficient in scientific knowledge.

THE ANTIQUITY OF AMBER.

The masses of amber thrown by every storm on the strands of Jutland, although neglected by the first settlers, attracted the eager attention of their sepulchre-building successors. The submarine product cast at their feet by the waves served not only for the adornment of the person but also for protection against supposed evil influence. Gradually it became known in distant countries and was bartered in the trade centres of the south.

The traffic soon attained large proportions. With the diffusion of the fossil gum of Jutland from Liguria to Thrace there was a corresponding plenty of bronze and gold in Scandinavia, where wrought amber and the objects purchased with it suggest a reciprocal relation.

About the sixth century B.C. the Etruscans entered the market. Amber is found on the oldest tombs at Cervetri, and its exchange for bronze wares explains the stamp of Etruscan design impressed upon many objects now in the Copenhagen Museum. Although the materials for their construction were imported, the discovery of the moulds in which they were cast proves conclusively that the weapons and implements of the bronze age in the north were of home manufacture.

The remarkable beauty and elaboration of these bronze implements are evidences of an advance in taste ensuing upon the development of commerce, while the system of ornamentation adopted in them betrays an Oriental origin. Its elements were probably rooted in religious symbolism, fire, for example, being denoted by the zigzag and the sun by the double spiral characteristic of Danish bronze work, although this is also found on the pottery of the beehive tombs of Mycenæ.

THE COMING MAN.

It is a fact, we are assured of by paleontologists and anthropologists, that primeval man not only had four more teeth than men now have, but had fewer bones in the skull and less foldings or convolutions of the brain. The form of the skull has changed according to environments and use from very elongated to very round, or to a compromise of the two. The jaw has retreated as the front brain has protruded. The tearing tusk teeth have shortened up and are neatly and gently inclosed in the mouth. Ears, from being pointed and movable like horses' ears, have become rounded and firmly fastened to the head. They are no longer the most important organ, as they were to the river driftmen to enable them to hear the approach of danger from all sides. The nostrils, from being open and alert, have closed up to outside affairs to a great extent, and serve mainly as conduits and as expressors of mental emotion. The eyes are shortening in their range of vision and adapting themselves to a bookish race. All the senses were once intensely more acute, and the tendency now is steadily to lose more and more of their capability to gather in the world of sounds and sights, except as these are correlated into logic. That is, we can no longer tell poisons by taste and track our enemies by scent, or distinguish dangers by the rustles in the air. Occasionally a child is born with peculiar gifts of an organic sort; can move his ears freely or shake his scalp. He does not use this faculty as it was originally designed to shake off flies or dust; indeed, it seems to be a useless reversion to a generally disused type.

Such changes in our general physical frame are startling and suggestive, but no more important than the mental and moral changes that are as demonstrable. Our ancestors, like the ancestors of all civilised races, were indubitably carnivorous, to the degree of cannibalism. The instinct for savage feasts and revelry involving bloodthirsty disregard of human suffering may lurk in us yet. The history of the Stanley expedition suggests that positive savagery is latent in us, in such degree that the absence of the restraints of civilisation may cause it suddenly to blaze with ferocity; yet, we certainly are transformed to a deep abhorrence for customs that our forefathers held to without a qualm. Changes in customs are easier than changes in organic structure, but both are easily possible. The rudimentary tail is still in our possession, and doubtless if advantage could be found in its development, we could get back this appendage in its fulness. It would not be impossible to develop a race of men with tails, if tails could be used. Certainly highly civilised races have lapsed in morals and intelligence to savage and animal conceptions of life. Such changes grow together and are interlinked. As the eye and ear are less occupied in detecting the approach of dangerous foes, they are more occupied in listening to the sorrows of our fellows. The pathos and sympathy of a noble eye, the keen intellectuality of a student's nose are part of the evolution; the organ changes, and at the same time exchanges purpose and power.

Darwin says: Man may be excused for feeling some pride at having risen, though not by his own exertions, to the very summit of the organic scale; and the fact that he has thus risen, instead of having been aboriginally placed there, may give him hope of a still higher destiny in the future. Later Darwinism, however, lays more emphasis on the fact that evolution to higher stages is the result of effect; and that while some anthropoids and some human races went up, many others finally went down. Some scholars insist that the ultimate fate of all will be a check in the way of advance,

and then retrogression, until the animal plane is reached. It has been suggested that there are even organic hints in us of a higher and winged body. The nonsense of this is easily understood by those who know that the arms of men and the forelegs of quadrupeds and the wings of birds are all the same limbs, modified and reshaped by use and desire and selection. Wings could be developed only by making over arms and hands. Another point is not suggested in the quotation from Mr. Darwin: which is that man does not stand at the summit of the organic scale in some respects. His bones are inferior in flexibility to those of the feline order. But that constitutes no reason why he may not anticipate, as that scholar suggests, a still higher organic destiny. It is not at all probable that we have anything like the complete type of physical man as yet. If so, where is he? Is it the English, or the Russian, or the American type? Is it the Mongol, or the Saxon type? Is it the long head or the round head? Nature has for ages been working at these types and trying modifications and compromises. There are as certainly internal modifications of structure going on that we can not so easily trace. One race is subject to a class of diseases from which another is wholly exempt. The African is adjusted to a climate that kills the Caucasian. The Chinese never suffer from a class of diseases that kill us; and in turn do not endure where we are fearless. This shows that our internal mechanism has undergone selection and diversification as much as the external. How much more of such adaptation may yet take place? Our worst enemies are bacilli; and the energy of civilisation is just now expended in devising their mastery. It does not follow that a race might not be differenced from the common stocks that would be bacilli-proof. If we search for a higher ideal to which we should desire to see the future man conform, we could not desire much (if any) increase in bulk or height over the Chesterfieldian model. Man is a fine medium in size to secure the best results; that is, the largest population to a given area of well-fed individuals. Lessen his size and he could hardly have strength for necessary toil and tools, or increase his size and he would waste energy in the way of applied force. That is, a finely-developed European, at about the height of six feet, is as near perfection in size for human purposes as we can conceive. Nor can we look for much improvement in the muscular way, without anticipating loss in an intellectual way.

The best advances of the future will come, as they always have in the past, from two sources: First, from great individuals who secure an extraordinary influence over the masses, and thus attain magnificent self-mastery and attainments. This is what constitutes the power of Jesus, and in an inferior degree the power of Socrates, Goethe, Washington, and many more. Secondly, the race improvements will go on by means of wiser laws governing the propagation of the species, repressing the vicious and eliminating them from the catalogue of parents. Add to this certain natural tendencies to obliterate lower races, and we shall have assured improvement of the human type. Modern life also can count on this factor of improvement; that epidemics take off the vicious and devitalised first, exactly what war reverses, picking for its victims the finest youths and ablest characters. War seems likely to be eliminated; epidemics only can be met and resisted by those who obey the laws of life.

Probably the most important steps looking to human improvement will be the increased instruction in science, and the elimination of science from religion. We mean that false science is now, to some extent, infused in religion, not to the extent that it was formerly. We hear very little now of the body as an enemy, "the world, the flesh, and the devil"; but we do find it taught that a person may devitalise himself, become a wreck of passion, and have it all forgiven. This science is untrue science. The fact is humanity has always been compelled to face the consequences of its doings and choices. You can no more wipe out our individual wrong-doing than our collective. But on the other hand, our educational system must hinge on a knowledge of ourselves, physiologically and psychologically. The nervous system is the last work of nature, the crown of all; and it is our highly organised nerve system that gives us our rank in nature. Knowledge should point pre-eminently toward the understanding and best use of the nerves. Common apprehension goes no further than to conceive the nerves as very troublesome additions to a muscular system. The use of stimulants and narcotics is a wide-spread—nearly universal—abuse of the magnificent system that involves all of the telephonic and telegraphic, with all of pleasure and pain, all of hope and despair. True self-knowledge, a scientific apprehension of one's duties to himself, underlies any individual progress; but it also is a requisite to collective improvement.

By these means—that is, eliminating social effort, repressing the degenerating, the force of magnificent characters, and a general diffusion of scientific knowledge—there is good reason to expect a nobler type than we have yet seen. Precisely how much may come from such influences can not be fore-measured. There was no estimating the power of the man who invented the alphabet, nor of John Guttenberg and his types. But we may suppose that many such influential factors will hereafter appear. A very cool and scientific consideration of the past assures us that the progress of the future will not only be equal to that of the past, but will surpass it. Progressive tendencies multiply and act in geometrical ratio, rather than in arithmetical, as of old.

FEBRUARY.

In February, says *Child Life*, the ornithologist should note the migration of winter birds to colder climates. Ducks, specially mallards and other similar species, may be watched at this season with advantage, before they go north. The hedge-sparrow may be watched with great interest, to see whether or no it moults in general at this season, as its affinity with the warblers rather than with the titmice would then be established—at present a moot point. The entomologist may wander round with the chip pill-box and cotton wool for careful gathering of specimens, and trowel for pupa digging; oaks, poplars, and elms being his best hunting-ground. The side of the tree least exposed to the prevalent storms of the locality should be examined. He should look beneath the fir needles on the ground, in the crevices of the bark on trees, and pull up dead plants to examine them, and stir the heaps of dead leaves. He may find larvæ in any of these hiding-places. Field mice and squirrels awake from their winter sleep. Brimstone, clouded yellow, pale ditto, comma, small tortoise-shell, large ditto, Camberwell beauty, peacock, red admiral, and painted lady butterflies, and humming-bird moths and hawk-brindled beauties hibernate, as do many moths that appear in the following month. Eggars, great oak, engrailed, early moth, spring usher, dotted border March moth, may, however, be taken this month. Gervaise Markham, in his "Way to get Wealth," gives this month as for the sowing of cabbages, but later writers put this in March; in many country places, however, this is still done about January.

THE EFFECTS OF TOBACCO UPON STUDENT DEVELOPMENT.

By Professor Jay W. Seaver.

The following paper was read before the Society of Science, Letters, and Art, of London, 160, Holland-road, Kensington, on Tuesday the 19th ult. :—

The general interest that has been shown in some statistics recently published regarding the effect of the use of tobacco on the growth of young men leads me to make a more extended statement of the facts.

Through the assistance of several members of the senior class of Yale College who have kindly helped me in compiling my records and securing the exact data, I am able to make a more complete statement, and equally interesting, from a scientific point of view. The data at present discussed, relate to 187 men, composing the present senior Academic class at Yale. All of these men have been examined and measured at least twice during the course, viz., immediately after entrance, and in the last term of the senior year, with two exceptions. Over 90 per cent. of the men were also examined in the sophomore year, and many in the junior year.

The material is fairly complete, therefore, and the group large enough to eliminate the elements of mechanical error and chance growth.

A record of the users of tobacco has been kept at Yale for the past eight years, for the main purpose of determining the number of men who began the habit while in college, and, from the uniformity of the records considerable confidence has been felt in the results obtained.

On entering college, the class of '91 had a list of 38 tobacco users, or about 18 per cent. of the 205 men. At the beginning of the junior year, this percentage had been slightly increased, although 18 of the men who were recorded as tobacco users left the college, for one reason or another. At the end of the senior year, the record stands as follows :

There are 77 men who have never used tobacco.

There are 22 men who have used it slightly at rare intervals, of whom 6 have begun the practice in the last term of senior year.

There are 70 men who have used it regularly.

The growth of the men in four of the principle anthropometrical items, of varied character, is as follows :—

	Weight.	Height.	Chest Girth.	Lung Cap'y.
*Non-users	11·78 lbs.	·894 in.	1·74 in.	21·6 c. in.
Irregular users	11·05 lbs.	·788 in.	1·43 in.	14·45 c. in.
Habitual users	10·66 lbs.	·721 in.	1·276 in.	12·17 c. in.

If this growth be expressed in the form of percentage, it will be seen that in weight the non-users increased 10·4 per cent. more than the regular users, and 6·6 per cent. more than the occasional users. In the growth of height, the non-user increased 24 per cent. more than the occasional user. In growth of chest girth, the non-user has an advantage over the regular user of 26·7 per cent., and over the occasional user of 22 per cent., but in capacity of lungs, the growth is in favour of the non-user by 77·5 per cent. when compared with the regular users, and 49·5 per cent. when compared with the irregular users.

It has long been recognised by the ablest medical authorities that the use of tobacco is injurious to the respiratory tract, but the extent of its influence in checking growth in this and other directions, has, I believe, been widely underestimated.

*Metric measurements, also given by Dr. Seaver, are omitted.

Dr. Seaver's conclusions in regard to the dwarfing effect of tobacco are fully corroborated by the following statement by Professor Edward Hitchcock, M.D., of Amherst College, more recently published :—

The matter of tobacco smoking as an influence upon the physical development of Amherst students has been studied in the history of the class 1891. Of this class, 71 per cent. have increased in their measurements and tests during their whole course, while 29 per cent. have remained stationary or have fallen off.

In separating the smokers from the non-smokers, it appears that in the item of weight the non-smokers have increased 24 per cent. more than the smokers ; in height they have surpassed them 37 per cent., and in chest girth, 42 per cent. And in lung capacity there is a difference of 8·36 cubic inches [this is about 75 per cent.] in favour of the non-smokers, which is 3 per cent. of the total average lung capacity of the class.

Here, then, is scientific demonstration that the use of tobacco checks growth in weight, height, chest girth, and most of all, and most damaging of all, in lung capacity.

If this be true of young men so nearly grown as are college students, what must be its effect upon younger boys ? Their growth ought to be much more rapid in proportion, but their undeveloped organs cannot so well resist the influence of this poison, and they must be dwarfed and stunted far more than those who are older. Many imagine that it is "manly" to use tobacco. Instead, it hinders the growth of the user in all that goes to make a man.

ORIGIN OF CASTE.

The origin of caste in India was traced, by General T. Dennehy, in the International Oriental Congress, probably to the contact of the Indo-Aryans on their first migration with the uncouth, uncivilised aborigines of the countries which they traversed. The Aryans were even then highly civilised and careful as to personal cleanliness and religious observances, and naturally shrunk against contact with the unwashed aborigines. They were particularly so with regard to food, and hence arose the first manifestations of caste in the exclusion of strangers from their meals. This custom grew with years to be a cherished observance, and what was first a measure of hygienic precaution became an article of religious belief. The latter developments of caste corresponded with the guilds of European countries so prevalent in the middle ages. New castes were seen growing up in India as new necessities arose. For example, since the establishment of railroads it had been necessary to find pointsmen (switchmen) and firemen ; and these men being anxious to preserve the emoluments of their posts in their own families, are now actually crystallising into a new caste. The views expressed by M. C. A. Pret, though differing from these, were not inconsistent with them. He discerned the working of evolution in caste. The Indo-Europeans formed at an early period a social hierarchy which continued in full force long after the language spoken by them had ceased to be a living tongue. The general ignorance prevailing in primitive times necessarily involved the evolution of a priestly or teaching caste—the Brahmins. The necessity of having men always on guard against the attacks and invasions of neighbouring races with different tendencies led to the warrior class or caste. These two leading castes represented the two leading principles in the constitution of civilisation—the religious and the military. The civil principle, properly so called, did not come into existence till a later period.

MOLECULAR MOTION.

The physicist, may prefer to define molecules as those small particles of bodies which are not subdivided when the state of aggregation is changed by heat, and which move as units under the influence of this agent. To the chemist, on the other hand, the molecules determine those differences which distinguish substances. Hence the chemist's definition of a molecule: "The smallest particles of a substance in which the qualities inhere, or the smallest particles of a substance which can exist by themselves," for both definitions are essentially the same. When we try to contemplate the magnitude of these small particles, the mind becomes bewildered by the immensity of the minuteness, in the same way that it is bewildered by the immensity of the expansion when it tries to penetrate the uttermost depths of the celestial spaces. But every child who sees the stars at night peers into these depths, and everyone who hears the whistle or the rumble of a steam-engine is listening to the sound of work done by the movement of these minute particles.

In the long series of experiments which enabled Mr. William Crookes to develop the radiometer and Crookes' tubes, he became very familiar with these small bodies; not quite enough so to handle them as a boy does his marbles, or a sportsman his shot; but he furnished abundant proof, if any further proof was required, that the molecules are separate bodies of matter, each with the capacity for its own proper motion and of doing its own proper work. It is true that he did not prove that one molecule by itself could be made to do work like a rifle ball, because he failed to separate one from all others; but he leaves no doubt that when moving together, like shot from a smooth-bore gun, each molecule has its own proper motion and does its own proper work.

Applying this determination to the phenomena of hydro-mechanics, the explanation it affords is astonishing for its simplicity. This application is entirely legitimate; for while Mr. Crookes' operations were on matter in gaseous form, it is now well known that all matter can be changed from one form to another, and the change of the substance which is the subject of hydro-mechanics, from the solid form of ice to the liquid form of water and the gaseous form of vapour, are amongst the most obvious of all phenomena. Moreover, the very fact that water flows, demonstrates its separation into particles each capable of independent motion of its own. When grain passes along a conduit or when seed or shot are poured from one bag or vessel into another, there is a flow, each particle having a certain motion of its own; one moves faster and another slower, as it happens to be more or less subjected to the impelling force. If the particles did not change position in respect to each other, the phenomena would be sliding, not flowing. The essential difference between sliding and flowing is that in the one case, the particles, large or small, constituting the moving body, do not necessarily change position in respect to each other, while in the other this change of relative position of the particles really constitutes the movement of the mass. This is beautifully illustrated by pouring corn into a bin. When the bag or vessel containing the corn is tilted the grains on top begin to move toward the lower side, and presently begin to pour over, and are followed by the others, each one moving in obedience to its own gravitation and the pressure, if any, from grains above it, and its movement is determined by the resistance it encounters from other grains and the sides of the containing vessel. When the operation is completed no two grains probably occupy the same position in respect to each other in the bin that they did in the vessel from which they were poured. It is said that no two grains are precisely alike in every particular, and it is certainly probable that when a mass of grain flows from one vessel into another, no two of them have identically the same motion both in direction and velocity. The gravitational pull on each is the same, but the variation in pressure and resistance to which they are respectively subjected is practically infinite.

This phenomenon of flow is impossible except in a mass composed of particles free to move in respect to each other, and, therefore, the flowing of water is itself sufficient evidence that the water is composed of particles free to move in respect to each other, and that this motion of particles actually occurs whenever water or any other liquid flows. The decomposition of water has demonstrated that the particles composing it are molecules, that is to say, the particles constituting the water itself are the smallest in which the qualities of the substance inhere, and not aggregations of these smallest particles. When a molecule of water is subdivided, as it may be, there is no water left; the water is destroyed, and the matter assumes the form of oxygen and hydrogen, which in certain combination form the molecule of water. (Decomposition, *ex vi termini*, imports a separation of particles. Thus when ice is decomposed into water, the particles separate, and there is a further separation of particles when water is decomposed into vapour; therefore when further decomposition destroys the substance itself, it is obvious that the substance must have been subdivided by precedent decomposition into the smallest particles in which its qualities inhere.) It is obvious, therefore, that a vessel full of water is filled with an aggregation of molecules, in the same sense precisely that a bushel measure full of corn is filled with an aggregation of grains.

It is not necessary for us to determine whether the molecules of water are held apart and kept separate by intermolecular vibration, as supposed in the kinetic theory; nor whether the atoms constituting the molecules "are in a state of vibration or rotation motion, in short, comparable to the bodies of the solar system," as suggested by Mr. William Crookes. These interesting qualities, supposed to be possessed by molecules, or by atoms constituting the molecules, but not by particles composed of an aggregation of molecules, are in no wise inconsistent with the obvious fact that molecules possess some of the qualities of other particles of matter; they are subject to the force of gravitation; that is, they have weight, and weight is simply the evidence and measure of the earth's gravitational attraction. Considering then, that a body of water consists of molecules in the same sense that a body of corn consists of grains, it is manifest that the molecules below the surface must sustain the pressure caused by the weight of the superincumbent molecules above, and that this pressure must increase with the depth, because the quantity of superincumbent molecules increases in the same ratio. An increase of pressure not essentially different occurs whenever particles of any kind are superimposed, as in a grain elevator or a brick wall. It is therefore obvious that nothing but the weight of the superincumbent molecules is necessary to account for hydrostatic pressure; and the molecules being free to move in respect to each other, all the phenomena of hydrostatic pressure must follow, under the general law of the conservation of energy, and its resultant, that motion is always in the direction of least resistance.

(*To be concluded next week.*)

TO INVENTORS.—Anyone having a good Invention can, on applying to the Editor, "Science Siftings," obtain the advice and assistance of a well-known Patent Expert, free of charge.

SPONTANEOUS COMBUSTION.

The tendency of many carbonaceous substances, both of an organised and structureless character, to combine with oxygen, under ordinary conditions, with evolution of heat, has been made the subject of much patient investigation, and a large mass of information relating thereto is now available. Inquiries in this direction, however, have had reference chiefly to the circumstances under which this phenomenon takes place, and to its prevention, with the view of obviating the disastrous consequences which it involves, when the temperature rises sufficiently high to char or to inflame goods of value. Much obscurity, however, still hangs round the question of the nature of the products formed at the commencement and during the progress of the chemical action, and any work done with the object of throwing light on this point would probably be productive of valuable results. The observed tardiness with which these substances combine with oxygen is more apparent than real, the time occupied being, not what is required for the action to take place, but rather what is necessary for the non-contiguous molecules to be brought into contact. There can be little doubt, says Mr. R. Tatlock, in a recent issue of the "Journal of the Society of Chemical Industry," that if the ultimate molecules of these bodies were in contact with the necessary oxygen molecules in sufficient number, combination would be instantaneous, as in the case of metals in the pyrophoric (in a finely reduced state, igniting spontaneously on contact with air) condition.

Nor is it even known whether the comparatively small proportions of oxygen which take part in such action combine with the entire complex substance—an oil, for example—or only with some part of it, leaving the remainder intact. In some instances, however, the nature of the chemical changes has been very fully ascertained, as, for example, in the heating of barley in the process of malting, by which starch is converted into maltose and dextrin, with evolution of carbonic acid.

The conditions which favour this low combustion are well known ; they are, first, the presence of the carbonaceous body, which must always be one that would burn in the ordinary sense if heated to redness in air ; second, the presence of air or oxygen ; third the presence of moisture ; and fourth, at least a moderate temperature. All these being fulfilled, the mechanical condition of the substance is of the greatest consequence, as, if it is either in a porous or spongy state, or in a condition of fine division, the facility for heating is greatly increased, while a calm and still atmosphere aid very materially. The following example illustrates the varied conditions under which this heating frequently takes place, particularly with regard to the nature of the material. A fire broke out, apparently spontaneously, in a workshop in Glasgow where "fire-lighters" were manufactured. These were prepared by mixing sawdust with melted resin in certain proportions. On the following day some of the finished goods which had escaped injury were taken away for investigation. One pound weight of these was placed under a glass shade with a thermometer, and in less than an hour the substance burst into flame. An examination of the sawdust showed that it contained a large proportion of moisture when mixed with the resin, and further experiments confirmed the view that this was the cause of the accident.

If we assume that a cubic foot of coal weighs 75 lbs., and a cubic foot of air 1·23 oz., and that for every three cubic feet of coal in hold, bunker, or store there is one cubic foot of air containing at least 0·28 oz. of oxygen, we have conditions equivalent to 2 cwt. of coal, having probably a surface of 50 sq. feet, practically in contact with the 0·28 oz. of oxygen, which, if it combined with carbon to form carbonic acid, would give out sufficient heat to raise the cubic foot of air from 60 deg. F. to 5,316 deg. F., which is much higher than the temperature of any blast furnace. Of course in practice this temperature could not be attained by the combustion of the oxygen initially present, as the heat would be partly communicated to the coal itself, and would partly escape with the warm air, for even if the atmosphere among the coal were dead still to begin with, the warmth imparted to it would cause it to expand, ascend, and pass away.

It has often been stated, and with truth, that chemical analysis throws no light whatever on the liability of a coal to spontaneous combustion, but while this statement is correct for such analyses as are usually made, it by no means follows that a chemical examination of the coal carried out on proper lines might not be useful in determining its qualities in this respect. The analysis required for technical and commercial purposes is one showing the percentage of carbon, hydrogen, oxygen, nitrogen, sulphur, ash, and moisture, but the relative proportions of these are not and never were intended to have any reference to the safety or otherwise of a coal for shipment or storage, and it is only such tests as are made with that special object in view that can ever be of value for that purpose. But while the elementary composition of a coal gives us no information on this point, it is extremely probable that a knowledge of its proximate constituents or compounds would be of great service. These are the decomposition products of the woody matter from which the coal was formed, but, unfortunately, little or nothing is known of them except that they differ widely in different coals, some of them being unstable in their nature, and, consequently, liable to chemical changes with production of heat, while others are of a stable character, and, therefore, not prone to such change. The subject affords a wide and interesting field for investigation, both for the scientific and the technical chemist. It is not at all unlikely, however, that experiments on the small scale, carried out upon the principal coals intended for shipment, might indicate the degree of their liability to heat and ignite spontaneously.

The spontaneous heating of oils in a finely divided state has been a subject of observation among chemists and others for a very long period, and the conditions under which it takes place are too well known to require any reference. All that is necessary is that the oil should expose a large surface to the air, and if the latter is warm and still, the action commences with great ease and progresses with astonishing rapidity. It has been, and still is, the result of painful experience, that many of the most destructive conflagrations owe their origin to the affinity of certain oils for oxygen, although there must be some instances in which this has been wrongly assigned as the cause. It is clear that any fire having its origin in a building, such as a Turkey red stove, where goods prepared with oil are suspended at a high temperature for a considerable length of time, would in all probabitity take place in one of three ways : —

First.—By the elimination of combustible vapour from the oil by the heat of the stove, producing an inflammable atmosphere, which would at once ignite on contact with a spark or flame.

Second.—By a spark escaping from a chink or crack in the heating flue of the stove (or brought into the apartment in some other way) coming in contact with the hot and dry goods.

Third.—By the extra heat—over and above that of the stove—generated by the oxidation of the oil; this would promote further action, developing more heat, and so the action would proceed, in an accelerated ratio, till the ignition point was reached, immediately before which a large quantity of inflammable vapour would be distilled off from the highly heated portions of the oil surface.

The first of these causes may be dismissed, as the amount of gas or vapour which could possibly be thrown off from the oiled goods would not be sufficient to form an explosive or inflammable mixture with the air, nor such as would ignite by contact of either spark or flame. The second could not and need not be made the subject of experiment, as the effect of direct contact with fire is obvious. It is only the third of these probable causes, therefore, that could form the subject of direct inquiry, and for this reason, as well as because it seems probable that the majority of disasters arise from this cause, it might be advisable in conducting experiments, to let them have the object, not so much of throwing light upon this point, as of determining in what direction investigation might proceed. Several very interesting experiments were, in fact, instituted in this direction by Mr. Tatlock.

THE POLE STAR.

Polaris, or the pole star, is about a degree and a half away from the true north point of the heavens. It is getting nearer to that point, however, and will be at its nearest about 213 years hence, or in the year 2105. It will then be within half a degree of the true north point of the firmament, an angular distance equal to the apparent diameter of the full moon, as viewed by us. Then Polaris will gradually move away from this point—or, rather, the point will move away from Polaris—and 1,200 or 1,500 years hence they will be so far apart that Polaris will not be much of a guide to the north. About 2,000 years from the present time a star in the constellation Cepheus will have the honour now accorded to Polaris, but will lose it again in the lapse of time, when it will be won, 1,000 years later, by another star in the same group. Then it will go to a star in the Swan, and later on to Vega, the brightest luminary in the constellation of the Lyre, and one of the brightest in the whole heavens. When Vega attains that dignity, the earth and the universe generally will be 12,500 years older than they are now. Somewhere about 25,000 years from the present date the true north point will have swung back to the place where it is to-day. The cause of this movement lies in what is called the precession of the equinoxes, by which the earth gyrates like a top, the axis, in a period of 25,000 or 26,000 years, describing a small circle in the northerly heavens.

The well-known disinfecting and antiseptic properties of the eucalyptus plant have been taken advantage of by Messrs. William Knight and Co., of Archer-street, Camden Town, who have produced a "Eucalyptus Tablet," procurable at a moderate cost. It is well-calculated to prove a boon at the present juncture when disease is so rife. The miasmatic valleys in Algeria and Portugal, and a part of the unhealthy Roman Campagna have been rendered almost salubrious by planting groves of eucalyptus trees. If the trees themselves can have this effect on climate, how important must the very quintessence of the antiseptic properties of this plant prove to the sick room, and as a disease preventative even in the healthy household.

SPONGES AND SPONGE FISHING.

The sponge is an aquatic being, the true position of which in the organic system or scale remains at present unknown. The question as to whether the sponge is an animal or a vegetable has been the subject of long discussions, and opinions vary with the most eminent naturalists; but the work of modern zoologists leaves no doubt as to the animal nature of the sponge. It is composed partly of fugitive animal matter, and partly of a fibrous framework and crystalline particles, which solidify the animal parts in most specimens, and these are sometimes the only portion that can be preserved. This framework forms a kind of felting composed of numerous veinous fibres. It is not the only solid part of the sponge, however; for we find also spicules—small spindle-shaped bodies—pointed at both ends and generally siliceous or calcareous in nature.

The animal portion is a gelatinous and glutinous substance which impregnates the sponge in its living condition with a kind of vein, which is very perishable and therefore very little observed. That which has chiefly contributed to the recognition of the sponge as an animal is its chemical composition, into which nitrogen enters to the greatest extent. To sum up, therefore, the sponge may really be defined as a soft diversiform body, very elastic, more or less irregular, very porous, traversed by tortuous passages, open at the outside by well-defined mouths, and composed of a kind of subcartilaginous skeleton entirely nitrogenised.

Sponges have their abode in the sea, and are found in almost every latitude; but the number of species and their abundance varies according to locality. In warm climes they are abundant, and attain a height of thirty-two inches and a width of nearly three feet; while in temperate or frigid climates they are scarcer, smaller, and the species are less varied. Sponges grow abundantly upon rocks, to which they attach themselves in their youth by means of a gelatinous substance. Occasionally they cling so close to the summit that at low tide they remain uncovered for several hours together, indicating that they are able to withstand temporary privation of their natural element. It should be mentioned, however, that every species possesses this property in a different degree, according to the latitude in which it is found. There are two kinds of sponges more commonly known than others, the common sponge, which is soft, gluey, rounded, very porous, with large openings, and with a very jagged surface. The other sponge is the shaggy one, flatter, but equally soft, downy, very little arched, and its surface also very jagged.

The chief seat of the sponge fishery was formerly in the Red Sea, but it is now principally carried on in the Greek Archipelago and on the whole of the Syrian coast. There are also extensive sponge fisheries in the Bahamas. These Bahamas fisheries employ about 6,000 men and children, the greater number of whom belong to the negro race. This fishery is a source of very considerable revenue to these islands, and there is no special season for it. The sponge always abounds in one spot or the other around the islands. It is constantly growing, and the supply has hitherto never been exhausted.

Sponges of good quality are in great demand, and at prices which are not subject to any sensible fluctuation from one year's end to another. During the year 1890 over 693,000 pounds of sponges, representing a value of £6,400, were exported from these islands. The fleet employed in the Bahamas sponge fishery comprises about 550 schooners of from five to twenty tons each, and 2,500 small boats. The 6,000 people who work in this fishery usually begin from

childhood, and continue this occupation until incapacitated by old age. Independently of the boats which belong to the large vessels, there is a certain number of other small boats which follow in their train. These latter give a portion of their spoil to the proprietors of the larger vessels in return for towing and for the room given on the decks to their catches. The sponge is torn from the bottom of the sea, by means of a long pole, provided at one of its extremities with a strong hook. If the bottom of the water cannot be reached with this pole, the fishermen are obliged to dive, but this is a rare occurrence.

The "water glass" is an apparatus absolutely indispensible in sponge fishing; it enables its operator to readily distinguish the sponge at the bottom of the sea. It takes the form of a cone of wood, glazed at one of its extremities. Its length is about eighteen inches. By placing the glass end of the apparatus just below the surface of the water the fisherman is able to see the bottom very clearly, and taking the pole in his disengaged hand he strikes the sponge selected, hooks and tears it from the rock to which it clung. The sponge, when drawn into the boat, presents anything but the aspect to which we are accustomed. All its qualities are hidden. It is heavy and contains gelatinous and glutinous matter, which is freed by maceration and washing. The sponge multiplies in a manner which is a somewhat curious phenomenon. At certain periods there are found on the surface of the sponge small knobs of a yellowish colour; these increase in size and detach themselves, and are forthwith borne away by the tide. These knobs resemble inert atoms of gelatinous substance, but in reality these small germs possess an activity which the naked eye can not detect, but upon examining them with a magnifying glass it is seen that they are covered with small cells, which contain germs serving to set the small knobs in motion until they have arrived at a sufficient distance from their birth-place. The knobs then remain at the bottom of the water, drop their cells and become sponges.

After the sponges are detached they are cleaned, picked, and packed into balls, which are pressed and exported to all quarters of the world. The sponge banks of the Bahamas are most interesting to naturalists; they present a really marvellous spectacle. The clearness of the water enables the coral banks to be distinguished at a depth of several fathoms, and the variegated tints produced have an effect which is simply superb.

BEAUTIES OF THE EQUATOR.

The port of entry to the Amazon Valley is the City of Para which stands on the southern bank of the great river, and fears no rival city on the northern bank, because the shore is too unhealthy and too difficult of access ever to become inhabited. With never a blighting frost and with plenty of moisture—for a daily shower is expected to fall throughout the year—it is not strange that every inch of fertile soil under a vertical sun teems with vegetation, so that this little known city of the south is embowered in a luxuriant forest that sweeps away in every direction as far as the eye can reach, draping the whole land with fadeless green, and veiling the continent for 2,000 miles westward to the foot of the Andes.

In Para narrow forest paths terminate the city streets. The landscape is nearly the same at all seasons. Very few of the trees shed all their foliage before the new buds expand, and one leaf at a time falls silently, while others as silently unfold. Few flowers are found blooming freely in the shady recesses of this woodland. Occasionally by the path a solitary scarlet passion flower flames like a beacon from the green drapery to which it clings. In partially-cleared spaces, or upon the outskirts of the wood, white convolvuli and occassionally the purple and white passion flowers are to be seen, as also a plant which resembled the scarlet flowered canna. The blossom is quite small—perhaps because of the deep shade in which it unfurls its wide green leaves. Many of the trees have small or inconspicuous flowers; but some of the tallest ones open showy clusters of purple or of yellow flowers.

The further we advance into the forest the less dense becomes the undergrowth, so that one catches more extended glimpses of the vast wilderness that sweeps away on either hand. But it is far from easy to make one's way from one path to another, as the tree trunks are everywhere linked and bound together by gigantic vines or sipos, and you begin to understand what is meant by climbing trees. Their flexible stems twine and creep in every direction or fall in loops strong enough to make a swing for two or three adults. Their leaves are mostly borne when the leaning stems have at last wound their way up to the sunlight that sifts into the dense canopy of foliage which is supported by the columnar trunks of the trees. Underneath this high, green firmament the bare, brown, vine-like stems and dark tree trunks are here and there interspersed with long brown threads that dangle over the pathway and sway with the passing breeze.

The green leaves of the enormous air plants, or parasites, give tone to the greys and browns of the bare trunks, and to the vine stalks that appear almost sombre in the semi-twilight of the woods. It is a marvellous sight to see wide, flag-like leaves growing luxuriantly in massive clusters at a dizzy height upon the side of a gigantic tree trunk. In some strange way many of them have been supplied with a big lump of black soil. One might imagine some grotesque gardener had uptorn the huge root from the ground, and in some magic way, flung it, with the soil clinging to it, right side up with care, against its perpendicular perch. Too rank a growth or some mischievous flying missile may dislodge one, but many are left to cling among orchids or ferns, whose home is high on the bark of the tree.

The weedy lianas, suspended from the branches above, are not the ends of vines that have lost hold upon their supports, but they are the air roots of epiphytal plants that are growing on the interlocking boughs. Some hang like scattered threads of fringe, other strands are clustered, but all are stretching and reaching toward the bosom of the earth, and when they touch the ground they quickly strike their rootlets into the moist soil, no doubt giving new lease of life to the plants lodged on the tree above.

Except in the moist and densely-shaded parts of the forest the ground is thickly covered with lycopodiums. They grow a foot or more in height and then bend over, to take root again at their lips, like walking ferns. This foot-deep, dark-green, mossy cushion is in itself worth all the trouble it takes to visit it. In the swampy localities we find paladiums that are especially graceful in style of growth and have very brilliant markings. Another plant whose thick, fleshy and hard-shaped leaves resemble the foliage of the caladium is the pothos. These climbing shrubs twine their cord-like stems around the trunks of the trees, here and there emitting false roots, by means of which they attach themselves to the bark of their appropriated support and clamber on toward the light that flitters through the interlacing boughs overhead.

An exceedingly interesting study is found in the almost endless variety in the foliage. There is every conceivable form between the fine pinnate leaves of the many mimosas and the sword-shaped leaves of the Urania Amazonica, wild banana, which measures 8 feet in length by 1 in breadth,

and stand upright from the top of a five or six foot stem. No words are adequate to express one's admiration for a single one of these stately colossal trees, and a chill of awe comes with the effort to estimate the number of these giants in the vast forest, whose majestic and imposing beauty is the slow and steady growth of unrecorded ages.

WOOD PULP.

Wood pulp is fast becoming an industry of large proportions. Wood fibre has come into general use as a substitute for cotton rags and other materials formerly employed in the making of paper. This fibre is called pulp, having taken the name which used to be given to the cotton and linen fibre when it had been prepared by maceration for spreading into sheets of paper. The wood fibre used to be prepared, only a few years ago, by a wholly mechanical process. The blocks of wood were ground or rasped off by action applied obliquely to the grain, the length of fibre dependent partly upon the angle at which the block was held during this process.

In place of the old mode of obtaining wood pulp, chemical treatment of the wood is now in vogue. As formerly, the bark is stripped from the wood to secure fibre of uniform quality. All discoloured or decayed parts are removed for the same reason. Then the wood is cut across the grain into thin chips, which are carried to the top of the mill and dropped into large drums about 14 feet in diameter and 24 feet long.

The drums are made strong enough to bear a pressure of from 75 to 200 pounds to the square inch. When a drum is packed full of chips, it is filled with sulphuric acid and other chemicals. The wood is converted into a cotton-like product, which is then pressed dry and mashed. It is next mixed with water, rolled flat, and cut into shape for bundling. In this condition it is said to be made up of 60 per cent. moisture and 40 per cent. fibre. In this shape it goes to the paper mill. It is found to be better to pay the freight on the contained water than to cheapen the cost of transportation by pressing out the water, for the pulp packs hard when it is dry.

One cord of spruce wood is estimated to make 1,200 pounds of dry fibre, worth from 4s. to 6s. a hundred pounds. A sulphite plant that will use up from 8 to 15 cords of wood every 24 hours' costs about £2,000.

THE signal "men" on two American railroads are women. They said to be most efficient at this exacting work.

ANSWERS TO CORRESPONDENTS.

SAMUEL BENNETT.—Many thanks for your kind wishes and resolves. We shall be pleased to hear from you from time to time.

J. S. STONE.—To blue small steel screws, first polish with emery paper and oil, then heat on a piece of metal plate over a gas flame. When the proper colour appears cool off in oil.

CHARLES WATSON.—The reason why your balloon will not rise is simply that the material of which it is made is too heavy. You have evidently been misled as to the proper method of construction. Under the circumstances, however, your best plan will be to try inflation with hydrogen in place of coal gas. You can generate your hydrogen in a corked bottle provided with a gas delivery tube and a glass safety funnel. The materials are scrap zinc and a solution of equal parts muriatic acid and water.

J. S. B.—The Leclanche batteries used for electric bells are recharged with a solution of chloride of ammonia. When the zinc has become corroded it must, of course, be renewed. It will seldom be necessary to replace or recharge the porous pot. With a very old battery this may be done, however. The charge consists of equal parts of crushed carbon and peroxide of manganese.

F. ELLINGWORTH (Oakham).—(1) We do not undertake to publish all the questions sent in. We select the most generally interesting. Yours may be published later on; we shall then remit. (2) The specific gravity of commercial cork is variable. Taking it at .24, a litre of cork would weigh 240 grammes. No gas, under ordinary conditions of temperature and pressure, weighs nearly as much as this. The answer to your query: "Is there a gas on which cork will swim?" is, therefore, no.

JOHN GIBBS.—Lacquer for the brasswork of photographic instruments, etc., is made by dissolving shellac to saturation in methylated alcohol. It is coloured by the addition of a little dragon's blood, gamboge, or anatto.

BEGINNER.—Yes, oil should be applied when turning wrought iron, but not to either cast iron or brass.

H. J. C.—The luminous filament in electric incandescent lamps is not platinum but carbon. Your idea of twisting the filament into a spiral shape is a good one, but it is by no means new. An article descriptive of the manufacture of incandescent lamps will be given in a future issue of SCIENCE SIFTINGS. The best light for lantern work is undoubtedly the electric arc; but we could not recommend you to set up a primary battery to work it, as the expense would be greater than is involved by the maintenance of an equally powerful lime light. If your lantern is to be used where a cheap supply of electricity is obtainable from one of the electric power companies, we shall be pleased to advise you more particularly. The addresses of several good makers of electrical apparatus may be found in our advertising columns, in previous issues.

PAINTER.—Water-colours are made by grinding up the pigments in either gum water, or honey. If they are intended to remain moist for a considerable time, a little glycerine may also be added.

JOHN B. ROBERTSON.—To make copying fluid from ordinary writing ink, it is only necessary to add a mixture of equal parts of saturated solution of loaf sugar and of gum arabic. Glycerine is also added in quantity corresponding to the length of time during which it is desired that the ink should remain moist after application to paper

R. VINCENT.—The subject is an unsuitable one for our columns.

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CORRESPONDENTS *must write on one side of the paper only, and those who are brief and concise in their communications will receive the first attention. If no reply be given to offers respecting contributions, correspondents may take it for granted that the same are courteously declined.*

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LONDON: SATURDAY, FEBRUARY 13. 1892.

SCIENCE NEWS AND NOTES.

"No pleasure is comparable to the standing upon the vantage ground of truth,"—FRANCIS BACON.

A Big European War,

or some similar sensation, calculated to fill the columns of our newspapers, would, anomaly as it may seem, be the saviour of this country, and reduce the death-rate to the normal standard. The newspapers are short of sensational matter just now, and, as we have said on former occasions, they are, to their shame, making the most of the influenza epidemic, and frightening the silly, nervous public into the extended arms of *la grippe*. Of all the newspaper men, Mr. George R. Sims is the only one who has had the honesty to decline to make "copy" out of this, and to declaim in the *Referee* against other newspapers doing so. Newspapers have a public duty to perform, and they have no right to unnecessarily rub the worst side of things into the public. The people who are dying now are principally old people, as anyone who chooses to analyse the death columns of the newspapers can tell for himself. The whole thing has been grossly exaggerated, and, as Mr. Sims points out, what we now require is a little more life, colour, common sense, and a little less mourning and panic. Attention to the hygienic conditions of our homes and streets, together with due precautions against infection, will do more good than agitation for Royal Commissions to inquire into a natural state of affairs dependent for the most part on climatic conditions.

Prevention is Better than Cure,

and, therefore, in addition to the advice we have given in the above paragraph and in previous numbers of SCIENCE SIFTINGS, we may remind our readers that, according to Dr. Parson's report of last year, the disease is alleged to be infectious at quite an early stage, and that it may remain so as late as at least the eighth day from the attack. It is also recommended that the assemblage of large numbers of persons in a confined atmosphere should be avoided. The incidence of the disease on members of the House of Commons, on the inmates of certain institutions, and on persons shortly after attendance at crowded meetings of various sorts must be within the knowledge of most people; and it should be remembered that in persons ill-fitted to withstand the disease even ordinary aggregations might properly be avoided during periods when influenza threatens or is prevalent. The *Lancet* draws attention to a point that we emphasised in our last issue. The need for restoratives at a certain stage of the disease has led some to resort to alcohol as a mere preliminary preventative. This is as great a mistake as the sudden abandonment of a reasonable and customary amount of alcohol. As the result of the former practice, not only does this stimulant become of little avail at a time when it might be otherwise helpful, but the power of resistance to the infection is distinctly lessened in advance by any improper and exceptional resort to stimulants; and hence the memorandum, in dealing with precautionary measures, utters a timely warning against anticipating influenza by any excessive use of alcoholic liquors. Exposure to cold, or to fatigue, whether mental or physical, should be avoided; wholesome food should be taken, and a good standard of health maintained.

Among the Vagaries of Influenza

are the rashes, typical of scarlet fever or measles, that accompany many cases. Mr. Ward, Medical Officer of Health for Harrogate, has attended at least six cases simulating scarlatina so closely as to give him anxiety in the early stages until he was able to exclude all but influenza as a cause. A case recently attended by Dr. Gordon-Black, of Harrogate, showed clearly that a rash, having all the outward appearance of measles, may occur in the course of influenza. The patient's neck and face were flushed, swollen, and covered by a roseolar, measly rash, which also extended over the chest, arms, and body. In some cases it is even said to require very intelligent diagnosis to distinguish influenza from rheumatic fever; so, what wonder that there is some confusion about the complaint, and seeing the mortality from measles has been somewhat extraordinary of late, is it not justifiable to ask whether cases are not being returned as measles which are in reality influenza with a rash?

The Sanitary Conditions of the Home,

is, of course, of vital importance at such a crisis as the present, as a person whose blood is devitalised by living in poisoned atmosphere will be the first to succumb to any disease that may be prevalent; and when once attacked will necessarily be less fit to resist a fatal issue than one whose blood is healthy. Drainage should, then, receive the first attention, and next the proper ventilation of living and sleeping rooms. To assist our readers to the first of these ends, we founded the "Science Sanitary Association." We have already a large number of subscribers, and those

who have not subscribed should certainly do so at once, and thus avoid the risk and responsibility of defective sanitary arrangements. The common sense of our readers should be sufficient to attain the second desideratum; windows should be opened in the early morning to allow the free ingress of fresh air; people should not crouch over fires; a thermometer should be kept in every room, and the instrument should never register over 60 degrees F.

Cremation

is now regarded by scientists throughout the world as the most sanitary mode in which to dispose of the dead. Even the Japanese, as we mentioned elsewhere, who ape European customs on the least provocation, and a few years ago commenced to imitate our burial customs, have had to return to cremation. The fact that the soil of graveyards is liable to become infectious and dangerous has rarely been disputed. Dr. Justin Karlinski, of Konjica, Herzegovina, has undertaken to determine whether the organs of the body undergo any change in temperature during the natural process of decomposition after burial in the earth, and especially whether any difference appears in the case of infected subjects. His results show that the putrefactive process is invariably accompanied by a rise of temperature above that of the soil around, and that the rise is higher when the parts examined have been taken from bodies that have succumbed to infectious diseases than from other bodies. He found that typhoid bacilli may retain their vitality in the decomposing spleen for three months, and are annihilated only by rapid putrefaction. Dr. Karlinski says that he had previously shown that typhoid bacilli could retain their vitality for five months in soil, but that if the earth were thoroughly saturated with rain water they are destroyed in from seven to fourteen days. The part played by the soil in the origin of epidemics should not, he thinks, be underestimated, since typhoid bacilli can exist in water only for a comparatively short time.

Insomnia

usually arises when physical exercise is not attended to. The great evil with brain workers is that they neglect this most important duty, and, as a consequence, suffer, at one time or another, the horror of prolonged sleeplessness. Walking is about the easiest method of bringing on that healthy weariness which is the necessary accompaniment of healthy sleep. The ordinary man, in order to secure the amount of rest necessary to recuperate the brain, should see, above all things, that his room is neither too hot nor too cold, and is properly ventilated. Hunger is another thing which banishes sleep. The old saying about going to bed on an empty stomach should be taken with the proverbial pinch of salt. A small quantity of food at least is desirable a short time before retiring to bed—desirable, we mean, for those who do not follow occupations which amount to physical exercise. Six hours' sleep is sufficient in ordinary cases.

Administering Physic

has been reduced to a fine art in some of the Paris hospitals, and a practice that obtains there might with profit be commended to the physicians and nurses of this country. Some years ago a leading physician in Paris, noting the strenuous objections entertained by many patients of the hospitals to taking medicine because of its noxious taste, conceived the idea that medicine should be administered in the food of the patients. He began a series of experiments to ascertain whether the taste of drugs might not be so disguised with food as to render them, if not palatable, at least less unobjectionable. The oils, such as cod liver oil, castor oil, and the like, he concealed in soups, and invented a peculiar bread known as the chalybeate bread, for the purpose of administering iron tonic, which many persons object strongly to taking on account of its taste. Every ounce of this bread contains one grain of the lactate of iron, and the quantity of iron tonic which a patient would take in the course of one day's meals would be quite sufficient for all medical purposes. The idea is not a bad one for our doctors to follow, for a patient with a weak or squeamish stomach is often put to no little inconvenience and suffering by the abominable taste of some necessary medicines.

One of the Most Curious Experiments

in the study of expression, and designed to prove the efficiency of certain sets of nerves in controlling the expression of the countenance, was made by Sir Charles Bell. Having closely examined the anatomical structure of a monkey's face, he chose a particularly ill-favoured specimen, a monkey which was famous for its ability in grimacing, and with a sharp knife severed the facial nerve on one side of the monkey's countenance. The result was extremely curious. The monkey made faces as vigorously as before, but only with one side of his face, the other remaining perfectly passive and motionless. Thousands of people went to see the animal, and a curious analogy was at once observed between the face of the monkey and that of an actor then popular in London. This actor was noted for his power in grimacing and making all sorts of odd faces with only one side of his face, the other remaining perfectly staid and sedate. An examination disclosed the fact that accidental paralysis of the power of expression was the cause of his peculiar accomplishment, and thus his face was precisely similar to that of the afflicted monkey.

Calming the Waves with Oil

has not always proved as successful as was expected. Herr Josef Grossmann, an Austrian mechanical engineer of some note, has been addressing a scientific audience in Vienna upon the question. The frequent failures that have been experienced in this direction, Herr Grossmann ascribes to a too indiscriminate use of oils. Purified petroleum, and in general, mineral oils, he says, are quite unsuitable for the purpose, even when poured by caskfuls into the sea. Train oil, on the other hand, is extremely effective. Even so small a quantity as half a gallon an hour will, he contends, secure a large vessel against danger. On the conclusion of Herr Grossmann's second lecture a discussion took place, and the meeting resolved to petition the Austrian Naval Administration to conduct an extensive series of trials with train oil in order to test its practical value.

Unconscious Influence

is a greater factor in every-day life than we are aware of. When so much is said by moralists about exciting a good or bad influence, that which the individual is directly conscious of is usually meant. Yet it can scarcely be doubted that the influence unconsciously emanating from every life is more important than its owner knows, or can begin to understand until the wider vision of the larger future life makes plain much that is doubtful and obscure in this. How little of what we know of the effect of our unconscious influence may be guessed in our ignorance of the causes that have combined in ways we cannot now see, to make us what we are. No one who has lived passed middle life will refuse to acknowledge that much the greater part of the influences that have determined his course in life were ordained for

him before his birth. Parentage, ancestry, even to the third and fourth generation, affect character so that it may be beyond the influence that can be brought to bear on the individual life. No one knows or can know the extent to which unconscious influence operates. In this life, slight and seemingly unimportant incidents bear fruit that astounds those who first influenced it. Yet in the main, the actions of the present life bear their fruit in the greater hereafter. Herein is the greatest incentive to right living. Whoever has influenced men or women for good, that influence extends through life. It is equally so wherever the influence has been for evil. Some years before his death, Daniel Webster, the greatest statesman America has ever produced, was asked what had been the greatest thought of his life. With more than usual solemnity he replied : "It is that of my personal responsibility for what I do in this life to my Creator." It requires an intellect like that of Webster to think such a thought as this. To how many men, this thought, appreciated as it should be, must be overwhelming. If their lives have been wholly evil, that evil must go on in other lives through successive generations. But there is a brighter view of human future than this. No life is wholly evil, and the good influences which men exert, unnoticed perhaps at the time, enlarge until the good overcomes the evil. It is, in the long run, the good which survives, and the evil that is overcome and perishes. Only thus, could the good finally be triumphant, as the seers and prophets in all ages have believed it will be.

A Hirsute Horse

whose tail and mane trailed for many feet along the ground was a much discussed phenomenon a few months ago. This discovery somewhere in the back woods of America, has, of course, been followed up by the appearance of a horse absolutely destitute of hair. Neither neck nor tail nor any part of the body shows the least hirsute growth. The texture of the skin is silky and smooth ; the colour is almost a full black. The animal is of rather heavy type, and with his delicate surface does not produce any unpleasant impression. There are said to be two such horses known to exist in America, but the one referred to here is credited to Australia. The skin in one of these animals is affected curiously, the perspiratory function seeming to be absent. The horse does not sweat when exercised, and the mouth or nose seems to provide the escape for what would otherwise be true skin perspiration.

The Dead Sea,

according to Dr. Lorter, in his curious report published in the organ of the Palestine Exploration Fund, loses every day by evaporation no fewer than 6½ million tons of water, the valley wherein the sea—which is of about the size of the Lake of Geneva—is situated, being one of the hottest parts upon the globe. The vast basin in which it lies is also remarkable as the deepest depression upon the surof the earth, being more than 1,300 feet below the level of the Mediterranean. Rocky walls, rising to 2,600 feet, in height, surround it on all sides. It is nourished only by the river Jordan, whose constant tribute of waters must be absorbed by evaporation only, there being no outlet at any point. It is, as Dr. Lorter shows, more than absorbed. As a consequence, its waters have been concentrating more and more, and so great has its density become, that Dr. Lorter has ascertained by actual experiment that the human body floats easily on the surface without any exertion of hands or feet.

The Quantity of Alcoholic

liquor that may be taken with impunity at one time depends, as was said in a recent reply published in our Query and Answer column, on the individual. Mr. John J. Price, of Pewsey, whose contribution arrived too late for the competition, sends us the following particulars of a case that are of much interest, since some of our readers still consider the point debatable. Mr. Price says : "A case has recently occurred at Poole which proves conclusively that one pint of gin taken at one time is sufficient to cause death. A man named John Tomkins undertook to drink a pint of gin, and drank that quantity out of a pint cup at one draught. After some little time he became unconscious and continued in this condition until he expired, having lived about four hours after taking the liquor." It would be interesting to know if the deceased was addicted to habits of intemperance, because such a fact would tend to show that the same quantity of gin in the case of an abstainer would prove more certainly fatal.

Animal Advance

is certainly not confined to the instances specified by us in our recent article. Mr. Thomas Bowker calls our attention to a bird's nest that he discovered in the Kalahari Desert, South Central (*sic*) Africa. The nest is constructed of cotton. It is a large bellows-shaped structure, but the most wonderful feature is a watch-tower that the male bird erects under the eve of the entrance to the nest, which projects and protects the tower. The male never enters the interior, but sits in his tower, and in case of danger gives a signal, when the female immediately escapes. The architectural skill of this little bird is only equalled by the high instinct that causes it to disdain the comforts of the interior of the nest for the discomforts of acting as watchman over his home. The bird is locally known as the "toutobane." It is smaller than our wren, but larger than the humming bird. It is coloured grey with yellow breast and red legs. The egg is white and small. The nest is about 7 ins. by 5 ins.

A Comparison Between Two Naturalists,

Frank Buckland and those of the Rev. J. G. Wood, is drawn by Dr. Andrew Wilson. Both men exhibited rather a mild contempt for the labours of naturalists of the more purely scientific type, such as those who concern themselves, for example, with tracing out the pedigrees of animals. For men of the stamp of Buckland and Wood it was living, breathing nature which alone appealed to them. The mysteries of structure were simply regarded by them as necessary and convenient means of explaining how the living mechanism moved and pulsated. The flight of a bird, the polity of an ant hill, the ways of stickelbacks in nest building, and so forth, constituted to them the real natural history. Your scientist who grubs about a cod's head, and seeks to show its evolution from some other type of structure, and to enumerate and discuss its varied bones, would not, Dr. Wilson tells us, have received much practical sympathy from either naturalist. Yet both parties, he tells us, in this matter are necessary for the advance of knowledge. We cannot get on without our rigid scientist, and we certainly cannot progress without the aid of the observer of living nature. It is not given to every man to exhibit the power of unravelling the complexities of living structure and to explain the mysteries of development, just as it does not lie within the province of others to exercise the keen vision of the observer of nature, and to describe animals and plants as they exist in field, forest, river. or sea.

SCIENCE QUERIES AND ANSWERS.

A prize of two shillings and sixpence will be awarded for every interesting question asked by our readers and published in this column and five shillings will be given for every answer published. In all cases when a similar question or reply is sent in by two or more correspondents, the award will be given to the one whose letter is first opened, provided the subject is properly treated. Questions asked by correspondents and not replied to by our readers, may, if of sufficient interest, be dealt with Editorially.

Rules for Competitors.—(1) Only one question may be sent each week, but any number may be answered. (2) Write on one side of the paper only. (3) Envelopes must be marked "Science Queries and Answers," and must arrive not later than the Monday following date of publication.

The following are Answers to Queries published in No. 15 :—

13.—What is the most accurate method of keeping time?

The answer to this question is simply to keep a chronometer. It is of interest, however, to note that by mounting two or more chronometers, having similar trains of wheels, upon one sounding board, the rate of all the chronometers will be improved. Accidental variations are eliminated by this arrangement, the motions of all the different balance wheels being synchronised by the corresponding vibrations of the sounding board.

14.—Can a liquid be made to vibrate like a spring?

There are several ways in which a liquid can be made to vibrate in equal times like a spring or pendulum. Thus the mutual attractions of the particles in a mass of liquid, suitably supported, tend to give to it a spherical form, and if this form be disturbed it will be recovered after a long series of oscillations, under the influence of the same attractive forces. Sir W. Thomson has found that for spheres of water the period of vibration is $\frac{1}{4}$ second with 1 cm. radius and 1 second with 2·54 cm. radius, and these facts could be applied in an instrument for measuring time if there were no simpler methods.

15.—What is the best anti-fouling composition now in use in the navy?

Presumably that one answers its purpose best by which the largest sums are yearly diverted into the pockets of contractors. There is practically nothing else to choose between the different "anti-fouling" paints that are in use. It may be added that one of the most important applications of paint on board a man-of-war is to protective colouring. Hull, guns, and rigging should be coloured dark-green, or some other appropriate colour, instead of being ornamented as now for a bright target to the enemy's guns.

16.—I have a "Newton's disc" coloured red, orange, yellow, green, blue, and violet. On rotation it gives a grey instead of a white. Can I improve it?

The grey tint indicates that your colouring is fairly correct. But a moment's reflection will show you that the luminosity of the rotating disc cannot be equal to that of the disc of white paper, with which you have probably compared it in the same light. White paper is a good reflector for all the components of white light. Your coloured disc, on other hand, only reflects fractions of white light. Evidently it cannot reflect much more than, say, one-sixth of what corresponds to white light at any one point. But, in addition, there is a special loss due to increased absorption even of the colours reflected by the coloured disc. Illuminate it strongly, therefore, and the grey tint, which simply indicates deficiency of light, may be got to disappear.

17.—How is the electric resistance of stranded cables calculated?

There is no fixed rule. The resistance is lower, however, than that of the wires taken singly, but greater than that of a solid cylinder of the same weight and length as the cable. The medium between these may be taken as approximate. The weight of a stranded cable is on an average $\frac{1}{30}$ more than that of the same length and number of straight wires.

18.—Is it possible to eliminate the action of gravity in physical experiments?

For practical purposes the effect of gravity is nullified within a freely falling body. It is said that a passenger lift so arranged, as to fall freely through a considerable distance, will form one of the features of the World's Fair Exhibition at Chicago. The fall will be finally broken in a large bell-shaped vessel of water. Should this scheme be realised, many very interesting experiments could be tried during the downward journey of the lift, their results being, at the same time, recorded by the aid of photography.

QUERIES.

Replies to the following Queries must reach the Office by Monday, and will be published in the issue after next.

25.—Is death by hanging painless?

26.—Is the eye or the ear best suited as a medium of reception for signals to be instantaneously recorded?

27.—How can the speed of a cannon-ball be best measured, without the aid of electrical appliances?

28.—In the case of a railway train passing over a bridge, is the strain equal for all speeds?

29.—Is alcohol used by surgeons as an anæsthetic?

30.—Why do pieces of camphor dart about on the surface of clean, but not of dirty water?

THE MUSIC CURE.

The recovery of Philip V. of Spain from an attack of apparently confirmed insanity by the power of music is one of the most remarkable cures in medical history. Insanity was hereditary in the royal family, and when approaching middle life the King became moody, melancholy, and his mental condition going from bad to worse, settled down into what seemed to be confirmed insanity. In the year 1736 Farinelli, the male soprano, came to Spain on a professional tour, and the Queen, having without success tried every other remedy, determined to make an experiment of the power of music. Farinelli was invited to the Palace and requested to sing in the next room to that occupied by the royal sufferers some of the sweetest melodies at his command. He did so; the King roused at once, showed an interest that for months he had not manifested, and asked to see the singer, complimented him on his songs and requested a repetition. Henceforth Farinelli was a fixture in the Royal Palace, receiving 50,000 francs a year as salary, besides perquisites almost if not quite equal in value. For ten years he every night sang to the King four songs—the same four, the first being "Pallido il Sole;" the second, the "Per Questo," both by Hasse; the third a minuet with variations, the fourth being unknown. Farinelli rapidly rose to great power and influence, not only in household but political matters also, and as the King's favourite exercised a greater weight in State affairs than the most potent of the ministers. He remained in Spain for fifteen years, leaving only after the death of his patron.

TO INVENTORS.—Anyone having a good Invention can, on applying to the Editor, "Science Siftings," obtain the advice and assistance of a well-known Patent Expert, free of charge.

GLEANINGS OF THE GLOBE.

THE average number of American patents issued yearly is about 20,000.

THE number of newspapers published in all countries is estimated at 41,000.

AN acre of ground, properly cultivated, will produce 1,700 bushels of currants.

THE University of Oxford has the reputation of having been founded by King Alfred in 872.

THE smallest tree that grows in Europe is the dwarf willow. When at maturity, it is only a few inches high.

HUNDREDS of fish are still alive in the royal aquarium in St. Petersburg, which were placed there from 100 to 150 years ago.

SIXTEEN species of trees growing in the United States, sink in water. The heaviest is the black iron wood of Southern California.

M. PALMIERI, director of the Vesuvian Observatory, states that all the great eruptions of Vesuvius take place at new or full moon, and especially at the time of eclipses.

FROST has a variety of effects upon different products. Under the same influence, eggs will burst, apples will contract and potatoes will turn black.

IT is stated that the Inman steamers are about to adopt petroleum as their fuel. The fleet consists of six large boats, all of which are to have the necessary equipment supplied.

AN electrical department has been opened by Messrs. Dollond, the well-known opticians, of 35, Ludgate-hill. The department is under the management of Mr. F. Berrett, late manager to Messrs. Dale and Co.

MR. EDISON has suggested a new implement of warfare. He proposes to extinguish the enemy as the fireman treats a conflagration. The Edison hose, will, however, pour electrified water on the party to be annihilated.

JULES VERNE writes his extraordinary stories in a little room crowded with charts, electrical apparatus, and scientific instruments. Even in his most imaginary flights he keeps as close as he can to the line of scientific possibility.

DR. NANSEN in his next Arctic Expedition, intends taking with him a large dynamo machine for the production of the electric light. This will be the first occasion, we believe, on which the electric light has been used in Arctic expeditions.

IT will interest cremationists to hear that the Japanese, who some time ago adopted burial of the dead, in imitation of European nations, have reverted to their own custom of burning the dead, on account of its sanitary recommendations.

IT is said that a Frenchman has invented a new and ingenious frictional machine. Mercury is forced by means of a pump through the pores of a piece of chamois, and electricity in considerable quantities is generated by the friction.

MR. ALBION T. SNELL made the statement before the South Wales Institute a short time ago that he had demonstrated that electricity would pump water or haul coal with an efficiency which was something like double that obtained by compressed air.

THE silver in the United States Treasury if melted down into a mass would make a column a foot square and 6½ miles high. It would take an army of 220,000 men, each bearing 100 pounds, to carry it away. These men would make a file 80 miles long, occupying 30 hours in passing a given point.

EGGS may be preserved for two years by keeping them in a liquid made up as follows: Lime 1 bushel (slaked with water), common salt 2 or 3 pounds, cream of tartar ½ pound, water q.s. to form a mixture strong enough to float an egg. The liquid must be kept at a temperature of 40° F.

IT has been shown that the word "Hello," spoken into a phonograph produces about 5,000 distinct vibrations. Each of these vibrations is capable of producing one Morse signal. Why not equip one telegraph line with 5,000 telegraph operators and let each send a message? Or, better yet, duplex the line and use 10,000 operators.

THE colour of the iris is not uniform in any eye. Some eyes have spots, others stripes, still others blotches of white, green, blue, yellow, and black, and the eye takes its colour from the predominance of one hue. An eye that is considered grey will often be composed of black and yellow. An eye that is thought to be brown will be very dark red with spots of yellow or blue.

A BEQUEST of £40,000 has been made by Dr. Ignaz Hoppe, of the University of Basle, Switzerland, for the investigation of the nature of the soul. The interest of the money is to pay the salaries of a certain number of scholars—Protestant or Catholic—who are to live in a house provided for them, and devote their time to study and reflection on the subject.

A NOVELTY at the World's Fair will be a travelling "side-walk." You will step off the permanent way on to a slowly moving way, take a seat, and find yourself at your destination. The track will be "endless," 900 feet long, electricity the motive power, and while one portion moves 6 miles an hour, another at its side only moves 3 miles an hour. So progression can be made at either rate.

DR. ROWLAND'S spectroscopic observations on the sun have, so far, identified sixteen more terrestrial elements as present in our great luminary, making in all thirty-six identified terrestrial elements. As to others there is doubt, and further study is being made. Among the sixteen newly-identified elements in the sun are carbon, silicon, silver, zinc, and germanium.

M. GRANGER has just presented to the Paris Academy of Sciences a new cupric phosphide, which he has obtained in crystals, this being the only compound of phosphorus and copper which has so far been secured in a crystalline form. The crystals are hexagonal prisms, steel grey in colour, very lustrous, hard, and brittle. Heated to a dull red in contact with the air, the compound is converted into cupric phosphate.

BUILDING THE BODY.

While voyaging over many seas of experiment in search of education, some of us are beginning to apprehend that the golden fleece of mental culture will not create for us the symmetrical man or woman. As a consequence, various systems of bodily training are receiving close attention from teachers and reformers, while athletic sports are now honoured and encouraged in schools and colleges where not many years ago they were merely tolerated as safety-valves for unsubdued vitality. We are returning to Greek ideals, but the elimination of the mediæval and Puritanic expression of contempt for the body is a slow process, and the formula still meets us variously masked in life and literature. Now, it is the notion of the spiritualising effect of invalidism, or delicacy of health; their debasing tendencies toward selfishness and morbidity being ignored. Again, it is the exaltation of nerve sensitiveness into an evidence of refinement; forgetting that the healthy nerve, like the pure metal, stands the normal test put upon it, the flinching being a token of failure as the alloy is of gold. In another instance, it is the scorn for manual labour, although this indicates also the survival of feudal feeling. We call the hand the servant of the mind, thinking we have ranked it, but educating the blind shows us that it may turn instructor and incite its ignorant master to action.

This is an age of fads and fetishes, and, as we give up our idol of disembodied intellect, we erect a shrine to meaningless muscle. We have outgrown croquet and archery. Even tennis no longer suffices, and we are founding schools of physical culture and gymnasiums *ad libitum*. In truth, these are needed badly enough by the physically idle, and if strength of body is our aim, a beginning must be made somewhere in its training. Does it not savour, however, of absurdity that the girls, who had not long since were frowned upon for being "tom-boys"—*i.e.*, using their muscles in running and jumping—and afterward were cautioned against running up and down stairs or taking long walks, should be suddenly precipitated upon parallel bars and turning poles, where there is emulation and a slight danger of overdoing? Very far are we from believing in any inherent physical frailty of women, or that it is not good for a girl to turn a somersault or learn hand over hand. It is the inconsistency of such philosophy that calls for comment.

Unquestionably the best exercise is that taken in the open air; and rowing, running, walking, skating, horseback-riding, have for ever the advantage over indoor training, in that they oxidise the blood as well as develop muscle. Gymnastics, on the other hand, have two special claims—economy of time and defiance of weather. But it is not only to the gymnasiums, equipped with apparatus and superintended by doctor or professor, that we need betake ourselves if muscular development is our object. These are attractive, and have advocates enough. Within our doors there is a despised sort of gymnastics which has few scholars, fewer teachers, and stands in great need of intelligent attention. The evangel of cookery has been preached to us from all quarters, but what missionary has been bold enough to proclaim the use and dignity of house work?

"Nothing menial for me!" cries the ignorant woman; while her more intellectual sister exclaims: "Oh, I feel above such drudgery!" Alas! to what giddy heights must those minds be elevated which do not see the necessity nor compensation of muscular work! Mr. Gladstone can find refreshment for his brain in chopping trees, and an eminent jurist of the United States in vigorously plying the saw; but there are women so highly refined that they can no longer employ their muscles for any useful purpose.

That there is not much sanitary or strengthening influence in the operation of dusting is evident; and yet many women, disdaining heavier work, reserve this domestic duty for themselves and waste much time upon it. Muscular motion is of little value unless vigorous and swift. The slow walk and loitering movement do not rouse the blood from its torpidity. The lowliest labour when zealously performed may be followed by an unexpected hygienic effect. There is the instance of a penniless young man, threatened with fever in a strange country, shipping as a deck-hand to return and die among his people. During the voyage he scrubbed away the dirt from the ship boards, and with it the disease that had invaded his life craft. A story is also told of a family whose women were of the delicate, ailing sort. Misfortune obliged them to perform their own domestic work. What seemed for them a sad necessity proved itself a double blessing. They gained what they had never known before—robust health; and their enforced economy restored them to a prosperous condition.

Not all physicians are clear-sighted or independent enough to prescribe as did one of their number. A young lady supposed to be suffering with anæmia, nervous prostration, and other fashionable ills sent for the family doctor. "Is there anything I can do to get well?" she asked, after the usual questioning. "There is," answered he; "follow this prescription faithfully." The folded scrap of paper read as follows:—

"One broom: use in two hours of house work daily."

That domestic work is not without its æsthetic side many authors bear witness. George Eliot introduces us to Hetty Sorrel at the butter-making, and writes, "They are the prettiest attitudes and movements into which a pretty girl is thrown." But if dairy work is rapidly taking a place beside spinning and weaving as one of the picturesque employments of the past, what there is to do about the house may be also gracefully done. And here, it may be said of this as of all other work, the spirit and care we put into it endow it with beauty as well as health.

Aside from the physical view of homely gymnastics, there is a social and an economic aspect. Courtship need not wait upon a problematic income if the fair Dorothea has not only a clear head but arms willing to take up the burden of life equally. Does Hermann need to toil? She deems it incumbent upon her, unless busy with young children, to earn her own living within the home or outside of it. When women shall have been educated to a keener sense of justice, they will no longer imagine they have discharged their debt to the community by adding a few beautifying touches to the household furniture! Nor, although they fulfil the higher and more exacting duties of a mother, will they thenceforth fold their hands and do nothing. To be a good father does not absolve a man from work, neither does being a good mother exempt a woman from her share in the maintenance of the home. The maiden of to-day is yet enslaved by caste culture; but the maiden of to-morrow may scorn to be merely ornamental or useless. She may be too proud to allow her husband to support her in idleness and may refuse to be re-enforced by a Biddy or Gretchen unless there is more to do than one pair of hands can accomplish.

The practice of these domestic exercises has also an important influence upon household service. The mistress who understands all the work required by her, and performs part of it herself, rarely has any trouble with servants. But, in order to attain this result, she must know more than the manner in which any piece of work is to be done; she must

know how long it takes to do it, and, in order to estimate this justly, she will need to make practical trial of it herself without assistance. The knowledge and skill she gains in this way will also enable her often to suggest an easier method or better arrangement of work. The ridiculous requirements made in some households where there is a lack of service, and which result in frequent changes, would not be possible if the mistress had learned this lesson in its entirety.

Can it be repeated too often that it is the sign of ignorance to scorn any work well done, or the doer of it? Only when the dignity and importance of labour are rightly estimated can we hope for any well-founded social prosperity. While it is not suggested that wealthy women should discharge their servants and undertake their own domestic work, it may be urged that only good can come from their personal performance of some share of it—physical benefit to themselves and a more wholesome feeling for the labour of their necessitous sisters. Between the small minority who suffer from too easy living and those whose days are overburdened with care, there exists, especially in cities, a large class of women in moderate circumstances whose health would be greatly benefited by more physical exercise. These need not rashly bestride the bicycle, nor rush through the non-productive drill of the gymnasium as an only means of grace. They may garner their resources, develop their muscles in walking and in re-conquering a world of flexibility and strength which lies within their own thresholds.

HYGIENIC LAMPS.

A few months ago someone suggested in a French paper a platinum lamp for the consumption of tobacco smoke in rooms. The theory for this lamp was based on the knowledge that platinum at a high temperature possesses the property of condensing gas. The idea was seized upon by a French chemist of prominence, M. L. Muller, of 1, Rue Treilhard, Paris, who has now sent us one of his lamps. It is an elegant little affair, made of glass, with a perforated platinum cap, which, after being lit and extinguished, remains in a state of incandescence as long as the lamp remains filled. The inventor claims that beyond acting as a tobacco-smoke consumer, and a deoderiser, it possesses the power of destroying microbes and all morbid germs. M. Muller states that the lamp in burning throws out ozone, or any other vapour that may be desired, depending, of course, on the liquid with which it is filled. We quote the following from the communication with which we have been favoured:—"To understand this complex phenomenon one must first remember that wrought platina as well as sponge of platina possesses, at a high temperature, the property of condensing gas, and to facilitate in its pores the combination of the oxygen of the air with combustible gases (flameless lamp); one must also allow for a reflexible action, the heat thrown out by the platina gives rise to an abundant evaporation of alcohol; the vapour of the alcohol in passing over the incandescent platina dissolves itself, and sets free the oxygen, a part of which helps to activate the incandescence. Thus the incandescence of the platina accelerates the evaporation of the alcohol, and this evaporation helps to maintain the incandescence of the platina. The other part of the oxygen, thus set free, fills the room, and purifies the atmosphere; this newly-produced ozonised oxygen blends with the tobacco smoke and consumes it."

THERE are about 446 muscles that have actually been dissected and described in the human body.

MOLECULAR MOTION.

It is not necessary to consider in detail the phenomena of hydrostatic pressure, for they are the secondary and not the immediate results of molecular motion, that is, of the motion of the molecules constituting the water. This motion is the change of position of molecules which constitute the mass or body of water, in respect to each other, and is contra-distinguished from molar motion, which is the change of position of the mass in respect to other masses, or of part of a mass in respect to other parts of the same mass. Molecular motion may occur from convection without molar motion, as when heat below the boiling point is applied to the bottom of the vessel containing water; the heated molecules rise to the surface, and the colder molecules at the surface sink towards the bottom, the body or mass of the water remaining stationary. So there may be molar motion without molecular motion, as when a vessel full of water is moved from one place to another without agitating the water. But in the phenomena of flowing or pouring, both of these motions necessarily occur; there is a change of the position of the molecules if the subject be water, or of the particles if the subject be grain, seed, shot, etc., in respect to each other, and there is also a change of position of the mass in respect to other things, and of parts of the mass in respect to other parts of the same mass. When corn is poured from one vessel into another, we can see the grains change position in respect to each other, and if this did not occur we would know at once that the grain was sliding, not pouring or flowing. We cannot see, even with the most powerful glasses, the molecules of water: one grain of corn equals in bulk many billions of them; but the results of the phenomena of flowing and pouring water leave no more doubt that the molecules do change position in respect to each other, than if we saw the motion of each one separately. Indeed, if the lower part of the water in a vessel be coloured with sediment or other matter, and the water be poured into another vessel, we have visible evidence of the change of position of the molecules in respect to each other by the transfusion of the coloured particles throughout the mass in the second vessel.

Flowing and pouring are terms used to express different phases of the same phenomena. What actually occurs in every case of flowing or pouring is the transference of a fluid or semi-fluid—that is, of a mass composed of small particles—from one place or vessel to another by the action of gravitation or some other force acting directly on the mass itself, and not merely on the vessel containing the mass. We know by observation when this phenomenon occurs in a quasi-fluid, consisting of grains or particles large enough to be observed, that each grain or particle has a motion of its own, and is subject to the mechanical laws applicable to all moving bodies; and assuming the same to be true in respect to the invisible molecules constituting a fluid proper, we find an explanation of the phenomena of hydraulics absolutely simple and perfectly satisfactory.

It is difficult to understand what force could cause the portions of water retarded by the sides or bottom to spread themselves with constant uniformity over the unimpeded current flowing below the surface in mid-stream, and especially how the portions retarded by the bottom could rise up through or pass around the more rapid portions above them. But the phenomenon becomes very simple if we suppose that each molecule of the water has its own proper motion, governed by well-known mechanical laws. The impetus to the motion is determined by the pressure, and the actual motion is necessarily the resultant of the difference between

the pressure and the resistance. If there were no resistance to the flow of the stream, there would be constant acceleration of motion from top to bottom, just as there is in jets from the side of a vessel, the flow from each being determined by the pressure above it. But in a flowing stream there is great resistance from the sides and bottom, the resistance from the bottom necessarily increasing with the pressure, and this resistance which the molecules receive from the bottom is transmitted, just as pressure is from above, to the molecules adjacent to them. At the depth where the impetus to motion by the pressure from above comes into equipoise with the resistance to motion from below, there ought to be, as there is in fact, the greatest velocity of flow. The resistance from the bottom remains practically constant at any given place in the stream. Wind blowing up stream increases the pressure by holding back the surface molecules; hence this increase of pressure, the resistance remaining constant, causes the level of maximum velocity to descend. On the other hand, when the wind blows down stream there is a diminution of pressure, because the surface molecules are pushed forwards in the direction of their movement; hence this diminution of pressure, the resistance still remaining constant, causes the level of maximum velocity to ascend. When the flow is through a round pipe entirely filled with water, and under such pressure that the influence of gravity on the stream itself may be disregarded, it is obvious that the maximum velocity is through the centre of the pipe; the pressure is uniform in all parts of a cross section of the pipe, and the resistance from friction against the pipe is likewise uniform in all directions from the centre.

We may assume that, in all flowing bodies, the particles or molecules constituting the body in which the phenomenon occurs, whether visible or invisible, have each its own proper motion, determined by the forces and resistances to which it is subjected, and that the molar motion is made up of the aggregation of these molecular or particle motions,—and in this consists the specific difference between flowing and sliding.

This determination is evidently of theoretical importance in hydromechanics and in pneumatics, for the law must apply to the flowing of gas as well as to the flow of liquids, and it may lead to other determinations of great practical value in one or both of these sciences. But since Mr. Crookes has put the molecules of residual gas, in the bulb of the radiometer and in his tubes, to doing mechanical work, the basis has been laid for the development of the science of molecular mechanics, and it is in this new field that this determination has its greatest importance.

The eyes of scientists are being directed to what we might call the small end of nature, and we are discovering that microbes, bacilli, bacteria, etc., are of more importance to mankind than the cedars of Lebanon, or the beasts which roamed beneath them, or the birds which sought shelter in their branches. So in this new science of molecular mechanics, the way to which has been opened up to us by Mr. Crookes' researches, we have the promise of additions to scientific knowledge more important even than the magnificent results which followed the application of mechanical laws to the movements of the celestial bodies.

(*Concluded. Commenced last week.*)

BACK NUMBERS.

All back numbers of "Science Siftings" may be obtained either direct from the office, or through any respectable newsagent.

ELECTRICITY UP TO DATE.

Industrial exhibitions, in which all the paraphernalia pertaining to one single division or branch of art and science are brought together, for purposes of instruction and entertainment, are an institution peculiar to the present century, and it may be safely said that exhibitions of this limited character can nowhere be better or more effectively catered for than by the Crystal Palace Company. When, as in the present instance, one of the principal manufactures exhibited, plays an important rôle in modern specular art, the special fitness of the great structure at Sydenham to the purpose for which it was designed becomes so much the more evident. The public, at the present time, is more nearly concerned in the improvement of electrical appliances than in any other branch of technological work. The wonders of electricity thrill the popular as much as the scientific imagination, and for these reasons we venture to think that most readers of SCIENCE SIFTINGS will feel some degree of pleasurable interest in accompanying us upon our visit of inspection. After investing a shilling on the official guide to the exhibition, we glanced through this book on our journey to the Palace. The principal feature of the catalogue is a series of seventeen short articles, dealing generally with various branches of electrotechnics. Collectively the mental pabulum contained in these articles is far too weighty for digestion at one time. The articles will serve admirably, however, as an elementary work of reference, covering nearly the whole range of electrical industry. An announcement made on one of the front pages is deserving of special mention. It refers to the advantages offered to inventors, under the "Patents, Designs, and Trade Marks Act" of 1883. By this Act it is provided that, under certain conditions, an invention may be described or exhibited at industrial exhibitions without prejudice to the right of obtaining patent protection at any time within six months thereafter. Speaking now for the catalogue proper, we can only observe that, except in relation to the exhibits of H.M. Government, the bulk of the descriptive matter is of a very inadequate character. This is the more to be regretted, as we find upon entering the exposition that a number of minor exhibits are left to speak, if they can, for themselves. Being now surrounded by the marvels—the "first fruits"—of this age of electricity, we put the somewhat meagre catalogue into our pocket, and proceed, drawn by a natural curiosity to the machine-room, where the mainspring of practically all these wonders can be seen. Here is the source of those mysterious forces with which, as it were, the very air of the Palace is saturated. For modern science—very modern science—tells us that, in one of its manifestations, electricity is almost identical with light itself. Each is constituted by a state of vibratory motion in that mystic *ether* in which "we live, and move, and have our being." One is imbued, on entering these machine rooms, with a weird mental consciousness of some uncanny "powers of the air," of all-pervading "magnetic fields," "electric radiations," and other dark but potent forms of force. These hide in great coils of wire, or lurk about angrily-sparking dynamos, as if ready (so one with but "a little learning" in these matters might imagine) to spring out with very little provocation in some horrible manifestation of destructive violence. The steam engines and gas engines in these rooms wield their heavy cranks and whirl great fly-wheels at a rate conveying, perhaps, an exaggerated notion of the horse-power which they represent. But the absorption and utter disappearance of this mechanical

power in the hum of the truly balanced armatures, and the production thereby of equivalent but immaterial forces, is a matter sufficiently well calculated to excite astonishment. As the result of a better acquaintance with the subject, this astonishment is merged in admiration for the ease and safety with which these puissant electric agencies can be directed and controlled.

How is it, then, in the first place, that mechanical energy is thus absorbed by the nearly frictionless movement of a dynamo machine "bobbin"? We could not fully reply to this question and explain the transformations that take place; for this explanation belongs to etherial physics—a branch of science of which the foundations have but just been laid. A very few words will serve, however, to enounce the fundamental fact on which all dynamo electrical science is directly based. For greater clearness a specific illustration will be used. Take a piece of copper wire, coated throughout its length with cotton, or with gutta-percha, or some analagous material, by which it will be protected, or "insulated," as electricians say, from any metallic contacts. Wrap the middle part of this wire in spiral form upon a magnetised steel bar, and carry the two loose ends across the table, there joining them together in metallic contact; in other words, completing the wire circuit. Next, let a piece of soft iron be placed in contact with one end or pole of the bar magnet. They need not quite touch, for, if you will, a sheet of tissue paper may be interposed between them. Of course, the piece of iron is attracted by the magnet, so that considerable force may be necessary to detach it. Apply this force—pull the iron armature from the magnet—and note that here, as in dynamo machines, there is a transformation of mechanical into electrical energy. A momentary current is induced in the coil of copper wire and circulates throughout the metallic circuit.

This simple experiment is a typical example of the dynamic generation of electricity. For suppose that in place of one soft iron armature we employ two, or five, or twenty such armatures, and mount them in the periphery of a revolving disc or bobbin. Suppose the magnetic pole of the steel magnet to be mounted, with reference to these iron sectors, like the break blocks are mounted by the side of railway carriages and other wheels, *i.e.*, let the magnet pole be placed in close proximity to, but not in frictional contact with, the revolving ring of armatures. Electrical currents would be induced in one coil of copper wire each time that one of these armatures, in the course of its circular motion, was brought up to and pulled away from the magnetised steel. Thus mechanical power can be exerted in a convenient manner against the etherial "field of magnetic force," and results in the production of that other etherial disturbance, propagated in pulses wherever we may carry our wire circuit, that is capable of exciting such truly wonderful effects. We must not encumber this article with a full account of the developments, electrical and mechanical, by which modern dynano machines have been evolved from mechanism of such a simple type as that described. The subject may be dealt with, however, in a future issue. For, notwithstanding the complexity, or seeming complexity, of the relations between mechanical, magnetic, and electric forces, the evolution of these modern current generators, being due to the simple application of experimental facts, is quite susceptible of non-technical treatment, and of popular comprehension. Concisely we may sum up, as follows, the main points of difference between our simple illustration and the matured constructions seen in the machine rooms of the Palace. Here the stationary magnets, instead of being straight, are bent into a horse shoe shape, so that both of the ends or poles can be made use of. Very often a pair, or more than one pair of fixed magnets (usually described as field magnets) are employed; and these are, moreover, constructed of soft iron, not of steel, and are rendered magnetic by purely electrical means. Coils of wire are associated, not only with the field magnets, but also with the iron sections of the revolving bobbin, and the electrical circuit, in which each of these coils has to be joined at proper times, is completed by means of pairs of copper wire brushes, bearing on a "commutator" which revolves with the iron armatures, and carries radial strips of copper, insulated one from another, and suitably connected to the various coils of insulated wire with which we have said the iron armatures are wrapped. Thus all the momentary currents, of which a number may be generated by each revolution of the bobbin, can, if desired, be "rectified" or caused to enter the main circuit in an invariable direction. But in many of the machines manufactured by the Brush Electrical Engineering Company, Limited, of 53, Queen Victoria-street, E.C., which are now considered to be the most advanced, and the most highly improved type of electrical generators, there is not any such rectification. The currents, as they are generated alternately in opposite directions, pass directly into the main lines, with a frequency of alternation amounting to, perhaps, 100 in a second. As an instance of the mechanical excellence, which we find to be comparable with the electrical efficiency of these machines, we may add that Raworth's patent flexible friction grip coupling is used in all of the "direct driving" dynamos, that is on those which are supplied, with steam engines attached, for use in ship lighting, or for private installations. The result is that twisting of the armature—which has been hitherto a not infrequent accident with this description of machine—is rendered impossible of occurrence. The unequal wearing of the engine and dynamo journals is, at the same time, rendered devoid of evil consequences. The attention of visitors with mechanical knowledge should be directed to the method of lubrication adopted by the Brush Company. Our limit of space has now been almost reached, however, and the remainder of the work displayed by Messrs. Brush (seen at their stand in the south nave, on leaving the machine room) must, therefore, be very briefly noticed. To the general public the most attractive of these inventions are probably the "search lights" or projectors, that can be fitted with arc lamps of up to 40,000 candle power. The projectors have simple but ingenious mechanism to "flash" the light for signalling purposes. Such lamps have become valuable aids to safe navigation; and, indeed, they are absolutely essential in some cases, as for instance in the night navigation of the Suez Canal. The "Mordey" transformers are also shown. They produce, from an alternating current of 2,000 volts, an induced or "secondary" current of only 50 or 100 volts pressure. Electrical induction between the coils of wire in transformers depends upon the numbers of the turns of wire. These govern the relations between the voltage, or pressure, of the primary and of the induced current. It is electrical induction, we may add, which is the cause of all the trouble inflicted by the neighbourhood of telegraph wires, on those who have to make arrangements for transmitting the weaker telephone currents. The same phenomenon can be most usefully applied for transferring electric signals from a train in motion to a fixed wire laid by the track, or similarly, perhaps, for signalling from ship to ship—Edison's suggestion—upon the open sea. We will deal with other interesting exhibits in the next issue of SCIENCE SIFTINGS.

JOTTINGS ABOUT JUPITER.

By Camille Flammarion.

Of all the floating islands which compose the celestial archipelago to which the earth belongs, the planet consecrated from the remotest ages to Jupiter the mighty, king of gods and men, is the vastest, the most important, and the most majestic. This colossal world of Jupiter has a diameter of about 88,000 miles, and which surpasses that of our earth by more than eleven times.

The circumference of Jupiter's world at the equator is about 275,000 miles. The volume of this giant exceeds that of the earth by 1,234 times.

This immense globe seen at the distance at which we are situated from the moon would appear to us with a diameter about forty times larger than that of our satellite, and the surface of its disc would embrace on the celestial vault an extent 1,600 times greater than that of the full moon.

This giant of the worlds travels through space, accompanied by a retinue of four satellites, at a mean distance of 496,000,000 miles from the sun, and which is more than five times greater than that of the earth from the same.

Its orbit is more than 1,000,000,000 miles in extent, and through this it passes in 4,332 days, or eleven years ten months and seventeen days. Such is the year of this immense globe.

In order to complete its entire orbit during this period, it speeds around the sun with a velocity of 700,000 miles a day, or a little more than eight miles a second. This is a little less than half the velocity of the earth in its orbit. But it revolves on its axis with a very great swiftness, for its day and night combined only last about nine hours and fifty-five minutes.

In other words, the inhabitants of Jupiter enjoy only five hours of real day, twilight included. "If," says Kant, "an inhabitant of Jupiter should die in childhood, having lived but one year on that planet, he would be as old as a child who should die on our globe at the age of 11 years and 314 days.

"The terrestrial child would have lived about 103,968 of Jupiter's days, and the child on Jupiter, 400,329 of the earth's days."

It is probable that this globe, although created before the earth, has preserved its pristine heat much longer by reason of its volume and mass. Is this characteristic heat sufficiently intense to prevent all manifestations of life? And is this globe still at the present time not in the state of a luminous star, but in the condition of a dark and burning one, entirely liquid, or scarcely covered with a first-hardened crust, as the earth was before life began to appear on its surface?

Or, indeed, is this colossal planet in that condition of temperature through which our own world passed during the primary period of its geological epochs, when life began to show itself under strange forms, as animal and vegetable beings of astonishing vitality struggled amid the convulsions and tempests of the new-born world? The last is the most rational conclusion that we can draw from the most recent and exact observations to which we are indebted for what we know of the present state of this vast world.

Whether Jupiter be inhabited now, whether it was yesterday, or whether it will be to-morrow, is of little consequence to the grand, eternal philosophy of nature. Life is the object of its formation, as it was the object of the earth's formation. Therein is everything. The moment, the hour, is of little account.

Doubtless the planet may now be inhabited by beings different from us, living, perhaps, in an aerial condition in the upper regions of its atmosphere, above the fogs and vapour of the lower strata, feeding on the aerial fluid itself, resting on the wind, like the eagle in the tempest, and ever dwelling in the upper heights of the Jovian heavens.

That would not be a disagreeable abode, although an anti-terrestrial one. Indeed, it would be like the abode of old Jupiter Olympus and his court. But if we do not wish, in our conception of life, to stray too far from the borders of the terrestrial cradle, there is nothing to prevent us from waiting until the planet has become cool, like our own, and enjoys a putrid atmosphere, which will permit its being compared with the earth.

And what would be better prepared to be the abode of superior life? It is the preponderant globe of the whole solar family, the vastest in surface, the most important as regards mass, the most favoured through the position of its axis, the most uniform in its course, rich in the possession of four satellites, and throned like a chief amid the planetary orbits. What marvellous conditions are prepared in this abode for the development of life, intelligence, and happiness! Ah, how much superior will such a humanity be to ours!

Happy shores of Jupiter! You will not know the distresses and sorrows at which the unhappy countries of our earth are still shuddering. You will not be moistened with the blood of martyrs, which has been so many times shed here in the name of so many contradictory gods. You will not bear tumultuous armies of brothers who periodically slaughter each other at the order of a few infamous potentates! You will not be defiled by the crimes that hunger, ambition, or pride is committing every day here below.

But you will prepare in the heavens the united states of an immense republic, blessed of the Creator, floating calmly in the luminous ether, bathed in the tepid temperature of an eternal spring, without winter and without summer, and slowly growing in the breast of peace and harmony toward a state of perfection, which our imperfect and miserable little planet will never approach.

It is impossible for us to imagine that the existence of the stars can have any other object than that of receiving or giving life. Life! Such is the grand object which we see shining in the destinies of the creation.

The absence of life is to us a synonym for death and nothingness. Our logic refuses to believe that the millions of suns which are burning in infinite space are of no use, and they neither illumine, warm, nor govern anything.

And if they are useful for something for us, this "something" is life, under whatever form it may be, from the simplest blade of grass up to the highest, most intelligent, most powerful mind.

This declaration, which is forced upon us by our own logic, is also the declaration of entire nature, whose unlimited fecundity has sown life around on every spot capable of receiving it; whose singular foresight gives things and beings even a double and multiple purpose for existence; who produces several effects through the same cause, and who goes so far as to accumulate life at the expense of living beings themselves.

If the gigantic world of Jupiter is now undergoing those conditions of temperature that marked the primitive epochs of the earth, we cannot consider it as being at present the seat of intellectual life.

It is the land of the ichthyosaurus, but not that of man; not the calm and tranquil world which is necessary for the manifestations of a delicate, nervous system and of contemplative thought. It is only later, in the future ages, that Jupiter will be inhabited by an intellectual race; and who

knows whether, perhaps, it may not be ourselves ?

Its situation then will be incomparably superior to that of the earth—an immense empire, a perpetual spring, long years and a mild, unvarying temperature will form an abode of peace and happiness truly worthy of our ambition and our hopes.

This majestic world travels in space accompanied by four enormous satellites. In what condition are those four worlds ? Are they not themselves, and have they not been for a long time, the seat of organic life, and even an intellectual one ?

Does not Jupiter's globe furnish them with a modicum of heat, and is it not to them a scarcely extinct sun ? The superior volume and masses of this planet, as it moves on, surrounded by these satellites, is a reproduction of the image of the sun itself in the midst of its four nearer planets —Mercury, Venus, Mars, and the Earth—for the distances and relative volumes of Jupiter's four satellites form a system which is singularly analogous to that of the four first planets of the great solar system.

Each one of the four worlds of the Jovian system has its special years, its days, and, doubtless, also its seasons ; and the inhabitants of each of them have also the same reasons for believing themselves at the centre of the entire universe, as the inhabitants of our little earth, who during so many ages have dreamed the same dream.

To them Jupiter's globe has the aspect of a gigantic moon, which is capable of effectually compensating for the small quantity of light they receive from the sun. Regarded from the first of the satellites, his immense globe appears 1,400 times greater in surface than our full moon.

What a colossus ! Even from the outermost satellite, the apparent surface of Jupiter still exceeds by seventy-five times that which the moon exhibits to us. What magnificent sights are to be contemplated from these observations ! Colossal Jupiter is the most marvellous object of their heavens ; to him he is the sovereign of the universe —the true Jupiter—and they admire him no less than we admire the sun.

For to them the sun is only a small, brilliant disc, whilst viewed from the first satellite, the immense globe of Jupiter exceeds it by 35,000 times.

Let us add the magic colourations which decorate this with glowing tints, from orange and red to violet and purple ; let us add, also, the rapid changes produced in its appearance by its rotatory motion, and we shall have an approximate idea of the magnificence of the picture as seen from these four worlds as they are carried along by the giant star into the far-off depths of immensity. And now a last question, and one of personal interest : What effect does the earth produce as seen from up yonder ? Assuredly a very ordinary effect as regards our vanity.

It is very probable that the inhabitants of Jupiter and the planets beyond consider the region of the solar system in which we live as empty. If Jupiter and the earth were to exchange situations the inhabitants of the former would see our globe as a pale star of the sixth magnitude, and scarcely perceptible to the naked eye, just as Uranus appears to us.

But in the position that we occupy with respect to Jupiter, the earth, at the moment of conjunction, is, like Venus, subjected to phases which render the whole or greater part of its disc invisible. Almost always lost amid the solar rays, it would appear like a black point when an observer on Jupiter chanced to see it pass across the disc of the sun, and not, as Fontenelle supposed, with the aspect of a star visible at night.

This little black point has not as much importance in the eyes of the inhabitants of Jupiter as that which Bismarck attached to the momentary possession of one of his minute provinces, and were it known on this far distant world that certain philosophers of the little black point had assumed that the whole universe was created and put in the world on purpose for them, there is reason to believe the whole population of the four worlds of Jupiter would be seized with a fit of laughter worthy of being sung by a Homer, and that the uproar produced would be so great that it might well be heard here.

SECRETS OF SUCCESS.

It is a singular fact that men who have achieved signal prosperity find it difficult to tell the secrets of their success. They are not able to determine the exact value of given conditions and influences, and do not always know the definite causes of particular results. There are elements of chance and accident in the problem which no one can fully comprehend. Things happen from time to time in illogical and surprising ways ; the tyranny of circumstances is an ever-present and potent force. The man does not live who is perfect master of his fortunes. Occasions come when his best calculations are at the mercy of unforeseen winds and tides, and all that he can do is to stand and wait. These fatalities have a tendency to make the most self-confident distrustful of their judgment and uncertain as to the real sources of their thrift and progress. So when they are asked to formulate a philosophy of success from the lessons of personal experience, they hesitate, and equivocate, and finally confess that they are not nearly so wise in this respect as they are generally supposed to be.

Nevertheless, there are some fundamental facts in the case that are easy to understand, and that always help to shape the course of the individual fortune. Men are placed in the world to succeed, and not to fail ; and the facilities of triumph are provided accordingly. There is no man so poorly equipped for the battle of life that he may not escape utter defeat. The most significant feature of the plan of the universe is that there is always another chance ; for every disappointment there is a new opportunity. When a man's calculations are frustrated to-day it does not imply that to-morrow will be equally unkind to him. It may be impossible for him to attain the complete measure of his ambition, but it is not impossible for him to win a victory of some degree, and thus to vindicate himself to the limit of his ability. A single test of energy and intelligence is never conclusive ; it is only by repeated trials that one's true capacity can be ascertained. The records show that reverses may be made to serve a beneficial purpose in the way of discipline and admonition, and that he is foolish who fancies that they are ever quite so bad as they seem.

One of the principal secrets of success, therefore, is pluck. Where that is lacking, other qualifications are of indifferent service. The habit of giving up, spoils many a career that tenacity and perseverance would render fruitful and creditable. A resolute adherence to the idea that victory is a matter of surmounting one obstacle after another, of rectifying mistakes and learning by experience, will do more for a man than any of those fine theories of avoidance and non-resistance to which so much value is often attributed. Our system of civilisation is not favourable to schemes of endeavour that include the possibility of despair or surrender in any emergency. Its prizes are for the aggressive and determined spirits that quickly recover from strokes of misfortune, and go onward again, undismayed and uncom-

plaining. In the life of every man there are seasons of special tribulation that demand special courage and fortitude, and it is his duty to be prepared for them. They constitute an appointed part of the struggle in which he is engaged, and upon his fidelity in dealing with them depends the issue of that struggle. To act a brave and steadfast part is to lighten the burden and to gain strength instead of losing it. The most useless of all practices is that of quarreling with fate ; the man of success accepts the situation, whatever it may be, and tightens his armour for further conflict.

This courage should have in it a quality of constant cheerfulness. A man need not be saturnine and disagreeable because he is brave and conquering. He will find it to his advantage to cultivate the art of looking and acting pleasantly, and to take amusing views of provoking things that readily relax their grimness when they are laughed at. The successful men, as a rule, are not sour and melancholy. They like jokes and funny stories, and have sunshiny ways of doing business. It is a great mistake to suppose that humour is mere froth and sparkle ; it has solid value as an agency of success, and nothing else will supply its place. Men have frequently failed for no other reason than that they were hopelessly incapable of appreciating the light and merry aspect of their surroundings ; and, on the other hand, men have often prospered by virtue of their jollity when they were defective in graver claims to public favour.

To courage and cheerfulness there should be added the faculty of tolerance in matters of taste and opinion. People take kindly to the man who recognises their right to think for themselves and to order their ways of life as they prefer. It is always unprofitable to assume airs of superiority and censoriousness. Human nature is so constituted that it resents such interference and such disparagement. Its self-esteem is easily wounded, and hurts of that sort are never forgotten or forgiven. The habitual fault-finder is never popular, for the simple reason that he disturbs the equanimity of society, and asks it to lower its estimate of its own worth.

There is such a thing as judicious and serviceable flattery, and the knack of administering it in doses to suit different exigencies is a very potent advantage. The leaven of vanity permeates the whole lump of modern character. It is not merely a superficial trait, but an inherent and pronounced quality, and serious account must be taken of it by the man who expects to accomplish his undertakings. The cynics delight to talk of vanity as if it were exclusively a feminine characteristic ; but the fact is men are quite as vain as women. A few compliments rightly bestowed will often influence a man who cannot be moved by the strongest argument, and it is the same with collections of men. The public mind is not always swayed by considerations of logic and sober reflection ; it may be captured by lighter means when they are skilfully employed. History is full of examples to justify the proposition that a policy of conciliation and commendation is as a general thing more productive of satisfactory results than the opposite one. This does not signify that it is either proper or necessary to act the hypocrite or to sacrifice honest convictions. It only means that there is a practical wisdom in taking men as they are and dealing with them along the line of least resistance, instead of trying to gain their confidence and support by arbitrary and belittling processes.

The observance of the covenances of society is a factor to success that should not be overlooked. Society has its mind made up in certain relations, and cannot be persuaded or constrained to change it. This is one of the first lessons that a young man needs to learn. The hereditary instincts of the race, the feelings that have survived through all the centuries, are factors to be treated with profound deference, and not with hostility or indifference. They enter into all the designs of fortune, and all the steps of destiny. It does not pay to disregard them for a moment. They can be utilised, but they cannot be repudiated. When sensibly considered and adjusted, they never refuse to promote a man's success ; but he must be careful to avoid all appearance of being their master rather than their supplicant. They can cause his efforts to be crowned with the fulness of victory, and they can as easily turn his projects to dust and bitterness. It is all a question of making the best use of given agencies and influences—of interpreting and applying certain well-established facts in an accurate and systematic way.

Another form of stating the case is to say that tact is indispensable to success. When that felicitous gift is absent, the task of getting on in the world is apt to end in defeat nine times out of ten. Fortunately, it is a merit that can be cultivated. It comes by nature in many instances, and persons so endowed are to be envied ; but the most helpless in that particular can acquire reasonable proficiency by study and practice. No one is so awkward and ignorant that he cannot learn how to strategise with sufficient skill for all ordinary purposes. A little tact goes a long way, and one need not use it continually. But there are times when the utmost stretch of wisdom is not of so much value as a bit of passing cleverness.

There are those who tell us that chances of success are not so good as they used to be in this country ; but such talk is contradicted by the daily operations of civilisation. The chances are just as plentiful as they have ever been, only they must be seized more promptly and skilfully. The measure of profit in proportion to the amount of business done is not as large as it once was, but the volume of business is very much greater, and so the aggregate gain is satisfactory. The call for competent and worthy men in all directions is loud and incessant. Any man who knows how to excel in any calling is always wanted and always sure to receive ample compensation. It is true to-day as it has been from the beginning that "checks and disasters grow in the veins of actions highest rear'd," and that men are, therefore, liable to fail in spite of all that they can do, but only those failures count to which the victims give consent by weakly folding their arms and refusing to renew the fight. The secrets of success are all founded upon the general idea that a man will not capitulate as long as he has strength left to make one more effort.

VOICE OF SCIENCE.

The Tides and the Stars, Sun Spots, and Spectroscope.

To the Editor of SCIENCE SIFTINGS.

SIR,—I have read the articles on "Tides and the Stars, and on the Spectroscope," in your present issue. I think the statement in the former article as to the rotation of Mercury and Venus should not be allowed to go unchallenged. It is true that the observations of M.M. Schiaparelli and Perrotin go to prove that those planets "always keep the same side turned towards the sun," but, on the other hand, the observations of no less careful observers, such as M.M. Niesten and Stuyvaert, Trouvelot, and Denning, on the contrary confirm the original determinations of Casini De Vico, Schröter, Beer, and Mädler.

The writer on the spectroscope cannot really mean what his words imply, when he says that the rainbow is "crossed by thousands of dark lines." The dark lines are seen in

the spectroscope in consequence of the rays of light being drawn into lines by passing through a narrow slit; this prevents the rays from overlapping. The rays in the rainbow overlap, and there are, therefore, no spaces between the different rays. Newton missed the great discovery of the absorbed rays through using a circular hole (which allowed the rays to overlap) for examining the solar spectrum. The lines divide the spectrum in the direction of its breadth, so that in a spectrum widened out into the form of a bow, the lines would run lengthwise and could not "cross" the bow.

Mr. Thomas Bowker, who writes to you on sun spots, has discovered a considerable mare's nest. It is true that the sun rotates in about 25½ days at its equator, but in the sun spot zone the rotation is about a day slower. Your correspondent forgets that the earth is moving round the sun; and consequently the sun has to accomplish rather more than one rotation before a spot returns to the same apparent position; the time taken is in fact about 28 days. Scheiner was, therefore, well able to make the 13 observations shown in the drawing in Sir R. Ball's book. Mr. Bowker, too, I may remark, says nothing about the distance between himself and the orange, which, of course, is an important element. What authority has Mr. Bowker for suggesting that the moon revolves round the earth in 30 days 5 hours? I noticed some large spots on the sun on Sunday; the present is, therefore, a good time for Mr. Bowker to make actual observations, which he can do with very slight optical aid.

I am, sir, yours faithfully,
ARTHUR KENNEDY, F.R.A.S.

Ashtead.

To the Editor of SCIENCE SIFTINGS.

SIR,—I was greatly interested by a letter appearing in your last number from the pen of Mr. Thomas Bowker.

It seems that by a simple experiment with such unpretending apparatus as an orange, your correspondent has discovered a singular mistake on the part of an eminent astronomer. This seems to suggest that men who have spent their lives in the study of science may have become so rooted to established methods, as to be blind to their defects. They need the criticism of the unscientific, whose plain common sense, untramelled by prejudice, will soon put matters right. Henceforward let science criticism be thrown open to the general public! Then will science flourish, and new methods invented by the people will solve all the difficult questions now perplexing experts.

But, in the midst of these cheering thoughts, suggested by Mr. Bowker's letter, I was struck by the idea that perhaps, after all, the orange experiment did not prove all that it was supposed to do. On examining it more closely, I found that there were not sufficient data to prove anything except that Mr. Bowker is probably rather shortsighted, physically, as well as mentally. For, on calculation, I find that he must have stood very close to the mantel where his orange was placed.

I should like to point out to your correspondent that the amount of surface of a "circular object" (as a slight acquaintance with trigonometry will show), seen from any position, depends upon the distance of that object from the eyes. At an infinite distance, half of the surface would be seen—the relative amount becoming less and less as the distance decreases. Now, as the sun is such an enormous distance away, we can assume without sensible error that half of its surface is always visible.

I therefore conclude that, although your correspondent has made, in the strict liberal sense, "closer observations than those of Scheiner," he might have asked your opinion privately before venturing to publish the astonishing results of his simple experiment.

Yours, etc., E. C.

ANSWERS TO CORRESPONDENTS.

VIATOR.—Our information was misleading as regards the G.W.Ry., as we learn that the distance between the telegraph poles between Paddington and Swindon varies from 60 to 75 yards, according to the number of wires and other circumstances.

NEMO.—We regret we are unable to open our columns to such a discussion as your letter would necessarily provoke. Our article on "The Warfare of Science" did not particularise. It was intended to be read in a general sense.

J. BARRINGTON.—To repeat Foucault's pendulum experiment, hang a globe of lead, weighing about 25 lbs., by a fine steel wire about 15 yards in length. Fix a pointer on the under side of the bob so that the plane of vibration can be accurately marked upon a sheet of paper, laid horizontally upon the ground at a distance of, say, one-eighth of an inch from the point. Next tie a loop of string or wire round the centre of the bob, and draw it aside by means of a strong thread. When all is steady, burn this thread. The loop should now drop from the bob, the pendulum swinging without any wobbling, such as would be communicated to it by the ordinary method of setting it into vibration. The plane of vibration will be found to have turned through an angle of 25 degrees in a little over 2 hours.

A WOMAN.—(1) No. Fortune-telling by astrology or palmistry is an imposition. (2) Act under medical advice. Those having a weak heart would run some risk. The brain would not be affected. (3) Pitman's system is the most extensively used, and, in our opinion, the best. (4) It is said that such dimples denote jovial amiability of character.

LIQUID GLUE.—Make very strong glue and add to each half pint, with thorough stirring, about 2 oz. of strong nitric acid, or substitute for the acid 2½ oz. of Venice turpentine.

ARTHUR JAMES.—The amount of gravitation force exerted between any two bodies is proportionate to the product of their masses, and inversely proportional to the square of their distances asunder.

A. GILCHRIST.—It is true that a spinning top, or rather a gyrostat, will maintain a fixed position, defeating gravity. But that is a very different thing from eliminating the action of gravity in physical experiments.

H. C. WILLIAMS.—We refer you to the published answers.

T. JONES.—We fear your method of timekeeping would not be very accurate. See the selected answers.

T. EVANS AND H. J. PARKER.—We believe the colouring to have been correct as stated in the published answer.

P. AND J. CARRINGTON.—Not quite up to the work.

T. WILMOT.—Notwithstanding the authority of Professor Zöhner, we cannot accept his conclusions.

A. MACIVOR.—Your method of timekeeping is undeniably good, but that published exhibits more ingenuity, and would probably be found accurate under a greater variety of circumstances. See reply to T. Evans and published answers.

F. STUART (Nunteath).—The answer selected is more direct.

E. LUGARD.—See published answers.

T. HUDSON.—We cannot say that the action of a force is eliminated simply because it is applied for equal times in opposite directions alternately.

T. MINSHALL.—You suggest an accurate method of finding, but not of *keeping* the true time. We refer you also to other replies to correspondents.

F. R. HUGHES.—We regret we cannot fall in with your views at present. We will keep your name before us for future reference.

RENOVATOR.—Yes, the silver-plating solution is easily made. Dissolve one ounce of double cyanide of silver and potassium with one ounce of cyanide of potassium in a gallon of water. Connect the carbon electrode of your battery with the silver plate, and the zinc with the article to be plated. If you intend the deposit of silver to adhere, your brass or copper goods must be thoroughly cleaned.

SOUTHWARK.—Your first question is replied to in our article on the Electrical Exhibition. A watt is a term used to denote the energy of an electric current. It is current expressed in amperes, multiplied by electro-motive force, expressed in volts. Thus a current of 2 amperes, at a pressure or electro-motive force of 50 volts, would be described as a 100 watt current; and a dynamo machine giving a current of 20 amperes at an E.M.F. of 50 volts, would be described as a 1,000 watt dynamo.

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Tariff: First 20 words or less, 6d. Every additional 3 words, 1d. If replies are to be addressed to the office of "Science Siftings," a charge of 3d. will be made for booking and forwarding replies.

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Exchange: We cannot undertake to receive or forward articles; money, therefore, to the estimated value of the exchanges should be deposited with us.

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Parlour telegraphing machine. Cost 84s.; quite new, only 13s. Hughes, 1, Romney-place, Maidstone.

Three telephone sets. Cost 8 guineas; what offers in bells, motor, or other exchange? 185, Cannon-street-road, London, E.

Wanted, small dynamo, perfect. Describe fully. Brown, 79, Victoria-road, Clapham, London.

Some second-hand entomological store boxes wanted. A. E. Gibbs, St. Albans.

For sale, splendid complete case of electrum mathematical drawing instruments. Cost £5 10s.; 55s. H. Doughty, 94, Albert-square, Stratford, Essex.

Medical galvanic battery. Cost £5 5s.; no use for it; bargain, £1. Brooks, 5, Fyfield-road, Brixton, S.W.

Wanted, a half set of human bones. Master, Science School, Llangollen.

Microscope for sale, high and low powers. Original cost 6 guineas, price 60s. D. Watson, 206, High-road, Chiswick, London, W.

Lantern miscroscope, Newton, with alum trough and live tank, 21s. Cornell, Tonbridge.

Binocular, powers 3, 2, 1, and ¼, spot lens, polariscope, usual accessories, good condition, in case, £7. Dr. Parson, Bracknell, Berks.

Boa constrictor's skin, length 16 ft. What offers? Dan Challis, St. John's-road. Newbury.

Four pairs horns, mounted, direct from South Africa, fine specimen, suitable for large house. Particulars on application to F. Crabtree, Selborne Mount, Bradford, Yorks.

Telescope field glass. almost new, a bargain, 42s. Sent on approval. McDowall, 12, Derby-street, Glasgow, W.

Telescope, powerful 3 draw, 18s., offers, exchange. Eads, Senwick-road, Wellingboro'.

Lancaster's ½ plate Instantograph, lens, tripod, instanto shutter, ruby lamp, 2 double dark slides, 3 printing frames, focusing cloth, 2 cloth backgrounds, 3 porcelain dishes, dry plates, and some chemicals, and other accessories for amateur, new 12 months since, as new now. Price 84s. Graves, solicitor, Buckland-errace, Plymouth.

Sale or exchange. Cassell's works, 30 parts; complete volume of Great Industries of Great Britain, cost 7d., take 8s. lot; 40 parts Our Own Country, cost 8d., take 10s., lot 15s.; also an electrical apparatus, cost 50s., take 20s. All parts sent on application to Emerton, Bourne, Lincs.

Edison's 'phonograph, talking machine, perfect condition, 30s. Lander House, Wood-green, London.

Bichromate battery, 8 1 pint cells, lifting apparatus, mercuric connections, complete, 20s. Rayner, Elmfield, Uxbridge.

Wanted, small galvanic battery. Lowest price for cash. Berry, Rushden, Northants.

Wanted, small dynamo. perfect. Describe fully. Brown, 79, Victoria-road, Clapham, London.

Wanted, Edison's phonograph, good. Cash or valuable exchange. Blake, St. James', Portsea.

Splendid collection of British and foreign butterflies, moths, and insects, in polished mahogany cabinet, in first-class condition, cheap, 100s. Wallis, High-street, Uttoxeter.

Twenty named fossils, 3s., free, cretaceous to carboniferous. Chas. Wardingley, Littleboro', Manchester.

Wanted, second-hand thermometer for gas stove, accurate to 500 degrees. Price to Thomas C. McMichael, Heath-street, Stourbridge.

Binocular, powers, 3, 2, 1, and ¼, spot lens, polariscope, usual accessories, good condition, in case, £7. Dr. Parson, Bracknell, Berks.

Microscopic slides, medical, educational, interesting, highest quality. From 2s. 6d. doz. (approval); sample, slides, and lists, 3d. Micro, 233, Maida-vale, W.

Excellent monocular microscope, 2 eyepieces, 3 objectives, mechanical stage, substage, Webster condenser, mahogany case. Cost £25; price £12. On view in London. 50, Castlebar-road, Ealing.

Wanted, achromatic ¼ or ⅛ objective, cheap. Stanton, 29, High-street, Bromsgrove.

Splendid pair stag antlers, with skeleton head, from noted Abbey, 30s. H. Chambers, Kempston, Bedford.

Birds' eggs, 150, between 40 and 50 varieties. Cash or exchange; offers invited. A. Mouland, 159, Elm-road, Kingston-on-Thames.

Collection of birds' eggs for sale, many rare. What offers? H. Roobottom, Elms, Alton, Staffs.

First-class ½ plate camera, lens, shutter, tripod, case, etc. Price £5 10s.; or exchange for safety. Chambers, 25, Summergate-street, Halifax.

Half plate photo set. Cost £8; price 90s. 7, Dereham-road, Norwich.

Lancaster's ¼ plate Le Meritoire, lens, stand, 2 slides, and bag, complete, 18s. Wm. Ferris Tayler, The Island, Melksham, Wilts.

Will give my ¼ plate camera, and all accessories, and cash, for ½ plate camera. Joseph Reay, Henry-street, Cockermouth.

Wanted, ½ plate or 5 by 4 camera, etc., good condition, cheap, cash. Jesse Brown. 19, Wilberforce-terrace, Argyle-street, Hull.

Wanted immediately, Lancaster's 1891 Instantograph, ½ rapid rectilinear lens, 3 double backs, sundries, cheap, good condition. J. B. Cumberland, 29, Alexandra-road, Northampton.

Triple mahogany body wanted, good, cheap. F. Gammon, 6, Macintosh-place, Cardiff.

Wanted, studio camera, must be in good condition and cheap. Particulars and price to Harrison, 9, Devonshire-road, South Lambeth.

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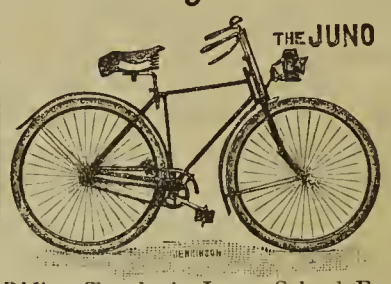

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LONDON: SATURDAY, FEBRUARY 20, 1892.

SCIENCE NEWS AND NOTES.

"The worst that can happen to you is to break stones; not to be broken by them. And for you there will come a time for better payment."—RUSKIN.

The Nerves

exercise a greater power over our well-being—psychical as well as physical—than is usually credited by the lay mind. Dr. James Goodhart, Physician to Guy's Hospital, delivered a lecture—one of a series—a few weeks ago before the Harveian Society, on this very subject, in the physical sense. The special purpose of this lecture was to show the connection between dyspepsia, or indigestion, and diseases of the nervous system. We have long ago come to the conclusion that all dyspeptics are neurotics in one form or another. Therefore we are not surprised to find Dr. Goodhart emphatically stating that there are only two forms of indigestion; that produced by over-eating and drinking, and that due to a failure of nervous power. There are other conditions that are met with as rarities, but who knows anything about these? Half the troubles with which our stomachs are worried result from sins either of commission or omission; and lucky it is the human stomach is so marvellously strongly constituted, and that of all the multitudinous sins of commission that are done to its would-be detriment there is, happily, not one in a hundred, if so many, to which it deems it necessary to turn a hair. Humanity is also to be congratulated that it is equally able to ignore the sins of omission. Were it otherwise, the human race would not last out two or three generations.

The Stomach is an Organ

that has been trained by centuries of custom, and by slow processes of evolution, to a condition of hardihood that endows it with the special attribute of comparative callousness, and "within limits," says Dr. Goodhart, referring to his doubts about the possibility of catarrh of the stomach, "and *mutatis mutandis*, I would as soon talk of catarrh of a bird's gizzard." Other so-called complaints of the stomach are equally imaginative and impossible.

Anything is Good Enough for the Stomach,

seems to be the general impression. Men go the City, for example, and, beginning at 9 a.m., go on till 6 or 7 p.m., and often enough bring home their business worries with them, their brains being all the while in a state of turmoil. In the midst of this they eat and drink, and ask their stomachs to digest. But if they have exhausted their nervous supplies—and more than exhausted, have overdrawn their capital of this, as they often have to do to no inconsiderable extent—where is the stomach to get its motive power? Women consume their nervous energies in even more ways than man. The neurotic woman is the type of the generation. Their stomachs, too, find themselves called upon to perform the impossible task of making bricks without straw. This is the indigestion of the present day!

How do we Treat Indigestion?

and Dr. Goodhart asks: "What is its rational treatment?" It is ten to one in favour of the patient getting a little soda and bismuth, or perhaps a little gentian and columba in addition. If the patient will run to it, he may take some rhubarb and magnesia instead, and generally, Dr. Goodhart believes, after this treatment, he at first leaves his doctor's door well satisfied that he has got his money's worth. But time goes on, he has consumed his appointed potions (most of these people take medicines well), and he does not feel any very sensible relief from the vagaries of stomach discomfort to which he has been subjected; and back he goes to the doctor and gets fresh treatment. Presently he will come to the conclusion that he is not placing his money rightly, and he will next be found in consultation with a stomach specialist, producing a bundle of prescriptions that for thickness may well make his face turn pale and his eye involuntarily seek the clock, while his ears will tingle with shame that any human being can be so bereft of common sense as not to have got his cure or let it alone ere it has come to this.

"Is there no Beam in our Eye?"

is the question that Dr. Goodhart asks the medical profession. He thinks there is a very big beam. And it is this, doctors are much too fond of giving a prescription because the uninstructed want it, and medical men do not ask themselves the question, "Is a drug the right treatment here?" Dr. Goodhart asks his *confrères*, "Will it ever come to pass that the public will pay us for our brains, and receive an order for physic as an evil, which, if it must be, must be?" He does not convey, however, that we can do without drugs, but that they are not *the* treatment. It does not follow because a man or woman has dyspepsia that bismuth and soda are forthwith to be shot into his or h

stomach. The great majority of the dyspeptics of the present day are so because their nervous power has run down, or has been incontinently consumed in other directions, without any regard for the needs of the stomach.

The Right Treatment

in these cases, then, is to take what steps can be taken to lessen the tax upon the nervous centres, and to tone up those that are run down. This is the pleasant prescription that Dr. Goodhart would like to write for his male patients:—£500 a year and an eight-hour day. For the female patient who frets her nerve force into useless fritters, he would prescribe "An occupation that shall give you freedom from yourself." Could these be given, the doctor's occupation, as far as treating dyspepsia is concerned, would be gone.

Want of Appetite

is the next great cause of dyspepsia. It is more common among women than among men, and results from feeble supplies of nervous energy. There are thousands of women going about who habitually have the smallest of appetites, and they are often enough women of very active habit of body and brain. It is notorious that when we have gone long without food, we soon reach a stage in which we do not care whether we have food or not. The supposition is that if no appetite exists, no food need be taken. So the case goes on, and little by little no food worth the name is taken. And we thus have an excellent illustration of upon how very little life may be sustained and even made to do quite a large amount of active work. The result of such starvation is that the stomach, gradually accustomed to diminishing meals, gradually shrinks and becomes inactive; and inasmuch as the bodily vigour runs at a gradually lessening tide, so it has less and less vigour, until it goes almost to sleep, and by slow degrees the digestive powers become more and more debilitated. Stomachics are no use in cases like this; the stomach must be educated back to a healthy habit, and be stretched to a more healthy capacity. It is food and not medicine that is the prime need of these people. Common sense principles are required. Dr. Goodhart does not hesitate to ask his brother doctors: "Do we always treat our patients to the same approved methods as we deem fitting for ourselves?"

Our Knowledge of the Brain and its Functions

is the most conspicuous feature of progress in physiological science. The advances we have made in this direction are founded on observation of how the brain acts in cases of disease and on experiments on animals. The fruits of these observations, Dr. Andrew Wilson considers, are many and great. Operations for the cure of brain tumours and other ailments of the central organ of the nervous system are now successfully performed. Cases which a few years ago would have been relegated to the domain of the hopeless are now literally rescued from the grave by reason of the physician and surgeon having been supplied with exact knowledge of the brain's functions. When a patient comes to the hospital presenting certain symptoms, such as the twitching of particular muscles, the physician knows the particular area of the brain concerned in the production of the twitching, and can act and advise accordingly. This, surely, is an immense advance in medicine and in science at large. Above all, it represents a beneficent measure of the highest order, since it saves many a life from extinction, and restores health and strength to many an otherwise doomed and hopelessly afflicted mortal.

Brain Science

has also progressed in other directions. We know more about the curious workings of the brain, in what may be called the ordinary round of its duties, than did our predecessors of even twenty years ago. Recently an illustration of certain interesting phases of mental action was afforded us by the researches of M. Séglas, of the Salpêtrière Hospital of Paris, into an unusual form of speech derangement. There is a not common affection of the speech-centres in the brain called "aphasia," in which, while the sufferer knows everything that is said to him, he cannot form words in reply. M. Séglas tells us that the affection he describes may be called "onomatomanie," and that certain very distinct varieties of abnormal brain action may be included under this name. For instance, there is a phase in which the person cannot recall a particular word. He gets perfectly agonised in his efforts to remember the term. Dr. Wilson considers this an exaggeration of a state perfectly common among us. Who has not experienced, when writing or talking, a sudden difficulty in finding a word ("the" word) which alone can express one's exact meaning? Then, there is a variety of the ailment described by M. Séglas in which one word gets into a persons's brain, as it were, so that he is seized with an irresistible desire to go on repeating it. Next comes a case in which a very ordinary word gets attached to it (in the opinion of the patient) some very terrible or peculiar meaning. It is for him a dread Shibboleth, which haunts him like a grim word-spectre. The fourth variety is that wherein a person fancies certain words have a talismanic meaning. Is this a survival of the "Abracadabra" of the old days of witchcraft and magic? Finally comes a phase wherein the patient takes a violent dislike to a word, and, as it is said, spits it out as if it had a disgusting taste.

These Word-Affections

are produced, Mr. Séglas shows, through complex brain-processes. In some cases the patients seem to be possessed by actual hallucinations regarding words, in others there is evidently exhibited a want of co-ordinating and controlling power over particular ideas. Thus, in one instance the words "vendredi," "malheur," and "treize" assumed to a patient an injurious and malign aspect. When they were heard, the words "samedi," "bonheur," and "quatorze" were expressed, as if to correct the influence of the former terms. In another case a patient appeared to experience a peculiar relation to the word "rage." Every time she met with the word it seemed to her to persist before her eyes, despite all her efforts to rid herself of the term. In Dr. Wilson's opinion, while showing us how complicated are our speech-efforts, the interest of these observations really lies in their showing us how our little and unheeded peculiarities of thought and word may become intensified under mental excitement into very marked departures from the type of healthy brain-action.

The Great Pearl Case,

as it is now familiarly called, again revives the theory that criminality is a disease. It is not going too far too imagine a time when it will be recognised absolutely as an inherited disease and treated accordingly. Those persons who display in youth a tendency to commit crimes will then be placed in institutions very different in character from prisons, where they will be constantly watched and encouraged to employ their abilities in those kinds of labour for which they are best fitted. In this way society will be saved from the consequences of the vicious instincts

of these people. In many cases careful treatment will doubtless cure criminals of their disease and enable them to return to the world and become useful citizens. In others they will have to remain under surveillance during the whole of their lives. Of course, men and women, not afflicted with vicious tendencies at birth will still be subject to temptations, and the law will be obliged to inflict penalties upon them for irregular proceedings; but the large class of inveterate law-breakers will be recognised as irresponsible for their ill-behaviour, just as people afflicted with hereditary diseases are never blamed for misdeeds.

The Supernatural?

is the queried title of a book by Dr. Lionel A. Weatherly, to which Mr. J. N. Maskelyne contributes a very considerable instalment. Dr. Wilson thinks it is a successful attempt to discredit the too common practice exhibited by many worthy persons nowadays of rushing into the clouds of speculation for explanations of certain occult phenomena, when better and more rational explanations of these curious phases of life are to be found at hand in the experiences of science. To peruse this volume is as stimulating to the common sense, as his morning cold water douche is to a healthy man. Continuing the simile, our critic adds that people who are not of a robust mental type, and who are inclined to lean to the mystical side of things, will not appreciate the stimulation in question, any more than a person of weakly physical constitution can enjoy the morning plunge. Mr. Maskelyne is specially hard (Dr. Wilson does not say unjustifiably so) on Madame Blavatsky and the Theosophists; and readers who wish for the latest information regarding the so-called "magnetic lady" will find in Mr. Maskelyne's appendix matter which will content them. The illustrations of the book are helpful, and some of them quaint. This work seeks to teach the public caution in discriminating between natural phenomena and trickery. There is a clear gain to our education all round when we are taught by medical and expert testimony, that we should exhaust all natural and known means of explaining the curious and abnormal side of life before we assume that anything, the causes of which we cannot easily or at once determine, must be relegated to the domain of "The Supernatural."

Hereditary Skill

is exemplified in no better manner than among Japanese workman. In Japan apprentices begin to learn the trades usually much earlier than in our country, so that when majority is attained the mastery of the crafts is thorough. Not a few of the famous artisans of the present decade are descendants in the ninth, tenth, and even twentieth generation of the founder of the establishment. A carpenter in Fukui can boast of his ancestry of woodworkers through twenty-seven generations; and the temple records show such boasting to be true, though often adoption interrupts the actual blood line. At a paper maker's establishment in Awotabi, in Echisen, the proprietor's ancestors first established the industry a thousand years ago. The same as above, so far as skill in the family goes, is as true of China as of Japan.

Artificial Globular Lightning

has been reproduced on a small scale by M. Planté by means of secondary batteries. M. von. Lepel has shown that it can be obtained also by means of static electricity given by an induction machine. When two small copper wires from the poles of a strong machine are held at a certain distance from the opposite faces of a plate of mica, ebonite, or glass, small luminous red balls will be seen moving here and there, at times slowly, at others rapidly, and sometimes in a stationary position. The most remarkable effects are got with a plate of glass or disc of paper rubbed with paraffin. M. von Lepel believes that the vehicles of the luminous phenomena are small particles of liquid or dust. A slight current of air will remove the spherules, which will disappear faintly whistling. The experimentalist remarks, further, that the phenomena are of weak tension. When this is increased the luminous balls are no longer obtained, but instead of them the ordinary spark-discharge.

The Antiquity of Steam Heating

can be traced to the days when Pompeii flourished in its original splendour. That steam was used for the purpose of heating buildings in that tine is evidenced by the signs which excavations have produced. A profitable hint might in in some cases be taken from the architects and engineers of those days, who held that the "true and reliable" way to utilise this convenient mode of heating was to build in the partitions of the houses hollow passage ways, into which the steam was supplied, when solely by radiation the desired heat was transmitted to the apartments to be warmed. With the introduction of pipes it was found more convenient and economical to convey the steam to hollow receptacles, which were set in the different rooms to be heated. The joints in the pipe in those days were made tight by the use of yarn packing.

328,000,000,000,000,000,000,000,000,

or three hundred and twenty-eight billions of billions of years is the time estimated by Herr Jager, a German astronomer, that it takes each star to encounter another. This estimate is based upon observations made by M. Hormann on the movement of 49 stars in the visual region. The savant claims that the solar system, with reference to the relative positions of the visible stars, moves with a velocity of twenty miles per second; the mean speed of the so-called fixed stars being about twenty-seven miles per second. This probabilities of a celestial cataclysm consequent upon the impact of two or more sidereal bodies are, therefore, apparently very remote.

One of the Most Extraordinary Boats

on the American lakes is a passenger car transfer ferry boat run in the Straits of Mackinac, by the Duluth, South Shore, and Atlantic Railroad. It has an enormous capacity for carrying cars, but its peculiarities are its strength, its shape, and the number of its steam engines. It carries twenty-four steam engines for the performance of the various requirements of its daily business. The hull of the boat is as solid as the walls of an old-time block house. The bow rises from the water so as to hang or slant over it, as if it were a hammer, and that is what it was built to be. The boat is an ice-breaker, intended to keep a channel open in the straits during the winter, or to make one whenever it is pushed into the massive ice that forms in that cold region. The big boat advances towards the ice, and, shoving her nose upon its edge, lifts herself upon it. Then a screw propeller under the overhanging bow performs its work of sucking the water from under the ice to enable the boat's weight to crush it down the more easily. Thus the destructive monster makes her way steadily through the worst ice of the semipolar winters of that region, climbing up on the ice, crushing it down, scattering it on each side and making no more of it than if it were so much slush.

GLEANINGS OF THE GLOBE.

An ocean pier at Puerto-Columbia, near Savanilla, will, when finished, be 4,000 feet long, built entirely of iron and steel, with a double line of rails.

Celluloid, among its other numerous uses, is now being applied to the manufacture of rules, set squares, angles, and similar mathematical and drawing instruments.

An optical or "magic" lantern, worked by artificial light, with a whitened screen instead of a condenser, is one of the latest inventions in lantern optics.

It is reported that a large steel company is experimenting with a process to render steel sufficiently tenacious to supplant copper for the manufacture of rods and wire.

One of the latest discoveries of medical men is that the germs of yellow fever may be conveyed from tropical countries in the plumage of birds.

The Hornbills of Africa and India plaster up and imprison the hen birds in a hole in the tree, with only a small hole left in the plaster through which to feed them and their young when hatched.

The view commonly entertained by naturalists, says Darwin, is that species, when inter-crossed, have been specially endowed with sterility, in order to prevent their confusion.

Sir W. Thompson concludes that the consolidation of the crust of the earth can hardly have occurred less than 20 or more than 400 million years ago, but probably not less than 98 or more than 200 million years.

The French Academy of Sciences has been devoting attention to the cure of hiccough. At the last meeting M. Leloir was able to announce that pressure on the phrenic nerve was the unfailing panacea.

A new fire extinguisher is composed of a mixture of water and liquid carbonic acid gas, which, upon being discharged through pipes at high pressure, causes the rapid expansion of the gas, converting the mixture into a spray more or less frozen.

The fossil remains of a strange bird, the Archeopteryx, were some little time ago discovered in the oolite slates of Solenhofen. It had a long lizard-like tail, bearing a pair of feathers on each joint, and its wings were furnished with two free claws.

Dr. Wyville Thomson says a sudden rise of an inch in the baromoter piles nearly half-a-ton extra upon our body, and yet, the fluids inside of us having proportionately increased in density, we feel only the more cheery and buoyant, because it requires a little less exertion to move in the denser medium.

The Optician suggests that spectacles with deep convex lenses, to overcome the refractive properties of water, may be made a useful commercial article as an adjunct to bathers in fresh and sea water, the difficulty of discerning subaqueous objects being thus overcome.

Indian fakirs think nothing of fasting for 30 or 40 days, and even a 60 days' fast is not uncommon. Quite recently two Bombay Jains fasted, one for 62, and the other for 48 days. How does this compare with the fasts of showmen who make a mystery about some ridiculous "elixir"?

An opera and field glass that will fold up to less than an inch in thickness, and is in other respects equal, if not superior, to the ordinary binoculars, is the invention of Mr. Aitchison, of Fleet-street. The body is composed of a very fine spiral steel coil, and the focusing is effected from the side instead of from the centre.

The telephotographic lens, recently invented by Mr. T. R. Dallmeyer, the well-known optician, is a wonderful instrument. It bids fair to accomplish for photography what the telescope has done for vision. Objects at several miles distance may, by its means, be as sharply depicted as those at a hundred yards by the ordinary means.

Professor Chandler has come to the conclusion that the poisonous influence of arsenic in green wall-papers is without foundation. After numerous experiments, he claims, that on analysing the air of a room, papered with the material in which there was notoriously much Paris green, no arsenic was discoverable.

The red colour of the markings on Jupiter is believed by Mr. Barnard, the eminent astronomer, to be an indication of their age, the spots or markings (other than the white spots) being dark or black on first appearance, but afterwards becoming red. The great red spot seems to be no exception to the rule.

Livingstone describes a curious insect that inhabits trees of the fig family. Seven or eight of them cluster round a spot on one of the small branches, and then keep up a constant distillation of clear fluid, which, dropping to the ground, forms a puddle. Naturalists are divided in opinion as to whether this moisture is derived from the atmosphere or from the tree.

One of the most forcible tributes to the genius of American electricians that we have heard of, was paid by the head of one of the most prominent electric-lighting companies in the United States, by refusing to fill an order for more of a certain staple article than would last two months. The reason he gave was, that in that period the whole system of incandescent lighting might be completely revolutionised.

It has been found by experiment that, as regards chemical composition, the susceptibility of iron to become brittle by pickling and rusting is least in cast iron and silicon steel, and highest in wrought iron, and, according to Badeeer, in high carbon steel. Combined carbon appears to increase the action and silicon to diminish it. The influence of manganese in either direction has not as yet been determined.

Little is generally known as to the great age which many trees attain. The elm will live 250 years, the cypress 275, the ivy 375, the larch 500, the orange 600, the olive 650, the cedar of Lebanon 750, the oak from 700 to 1,400 years, the lime from 900 to 1,000, the yew from 1,100 to 2,500, while the greatest patriarch of all is the Taxodium, which, from the number of concentric zones observed in a transverse section of the stems, has actually been proved to have reached the age of at least 4,500 years.

SCIENCE QUERIES AND ANSWERS.

A prize of two shillings and sixpence will be awarded for every interesting question asked by our readers and published in this column, and five shillings will be given for every answer published. In all cases when a similar question or reply is sent in by two or more correspondents, the award will be given to the one whose letter is first opened, provided the subject is properly treated. Questions asked by correspondents and not replied to by our readers, may, if of sufficient interest, be dealt with Editorially.

Rules for Competitors.—(1) Only one question may be sent each week, but any number may be answered. (2) Write on one side of the paper only. (3) Envelopes must be marked "Science Queries and Answers," and must arrive not later than the Monday following date of publication.

The following are Answers to Queries published in No 16.

20.—I have lithographs or engravings on paper that is printed on the back. Can I transfer or prepare them for exhibition by the optical lantern ?

Soak the paper in a solution of potash, and next in a solution of tartaric acid. By this means minute crystals of bitartrate of potash become diffused through the texture of the unprinted part of the paper. As this salt resists oil, a roller charged with greasy ink can now be passed over the surface without transferring any of its contents, excepting to the printed parts. Next wash and dry the paint, after which the freshly-deposited ink can be retransferred to a paper or other surface, by simple pressure in an ordinary hand press. This process, which is a kind of anastatic printing, has, however, become nearly obsolete, owing to the superiority and the simplicity of photographic copying methods. Another old transfer process is carried out by varnishing the plain glass slide with mastic varnish, when the engraving is laid face downwards on the still tacky varnish. After firm drying, the back surface of the paper is rubbed away with fine glass paper. If you desire to exhibit a large number of book illustrations by means of the optical lantern, it would be your best plan to make use of that form, known as the megascope or aphengescope, adapted to the projection of opaque objects.

21.—It was recently proposed by an American to make "air ships" of a thin steel shell, exhausted internally. Is the scheme practicable, and would it present any advantage over the ordinary hydrogen gas balloon ?

The proposal is quite impracticable, owing to the weight of a steel shell sufficiently strong to withstand the enormous crushing force to which it would be subjected by exhaustion. But even if the constructive difficulties could be overcome, any arrangement of air ship involving a non-elastic envelope, or a vacuous interior, must necessarily be far inferior to the existing silken gas balloons. These, when in condition for ascension, are frequently not more than half filled with gas. Their envelopes, are, therefore, for practical purposes, perfectly elastic. And as all gases expand by equal amounts for an equal reduction of pressure, it follows that, as such a balloon rises, the gas within it will maintain a constant density relatively to that of the air without ; and that the lifting power will be constant at all moderate elevations. Supposing a gas balloon with an elastic envelope to possess an ascensional force of 100 lbs. at the level of the sea, this ascensional force will remain unchanged at a height of say $3\frac{1}{2}$ miles. But supposing the envelope of the balloon to be non-elastic, the lifting power at $3\frac{1}{2}$ miles elevation would be reduced one half, that is to 50 lbs.

19.—Can messages be transmitted along a telegraph wire without affecting the simultaneous passage of electric currents through it ?

Yes, by disposing along the wire a sufficient number of "relays," magnetic impulses could be used for the transmission of signals, independently of any electric currents that might be passing simultaneously. Sound pulses can also be transmitted through a stretched wire, as in the so-called mechanical telephone. The speed at which pulses of sound would be transmitted through a telegraph wire is 16,000 feet per second. Theoretically, a fourth system of signalling, by mechanical means (as in the case of bell wires) would be possible, since, within moderate limits, a change in the tension of the wire would not sensibly affect the transmission through it of electricity, magnetism, or sound.

22.—Can the interior of an animal's body be illuminated by means of the small electric lamps, sold as "fairy lamps" ?

These lamps are used by surgeons to illuminate interior parts of the human organism. A fish, swimming in a glass tank, has been induced to swallow one of these lamps, without injury. By then passing a current through the fine covered wires attached to the lamp, it was lit up, and showed clearly every bone in the interior of the fish ; and this apparently without subjecting it to any inconvenience.

23.—Does science offer any prospect of cure for persons afflicted with total or congenital deafness ?

It has been found that electric currents of moderate intensity, passed through the ears, or from one ear to the nape of the neck give rise to sensations of sound, that vary in pitch with the intensity of the current, and that appear to be distinct from the ordinary mode of audition. The recorded investigations of this phenomenon are quite unsatisfactory—although one would have supposed that so interesting a matter would, ere this, have been fully inquired into. The experiments needed are perfectly simple, and can be performed by anyone. When they have been accurately applied, not only to hearing, but also to deaf persons, we may expect that considerable light will be thrown on the question at issue. Then again, it is well known that there is a continuity of sensation in touch and hearing. This is exemplified in the well-known experiment of "hearing" through the teeth ; and it has also been demonstrated by Dr. Stone, by a very striking experiment, in which the hands only are employed (Proc. Phys. Soc., v. i, p. 21). These facts, taken together with the now well-known means of obtaining mechanical and electrical effects proportional to the intensities and qualities of sounds, lead to the inference that but little difficulty should be encountered in adapting an instrument to confer upon totally deaf persons an artificial sense equivalent to that of hearing.

24.—What is the simplest and cheapest method of constructing a luminous water cascade for exhibition by a small magic lantern ?

Cut a circular hole, of one inch in diameter, through one side of a rectangular tin vessel. Cut, opposite to this, a hole of the size of the lens tube of your lantern. The latter aperture is now to be covered with a piece of sheet glass—a clear photographic plate will answer very well ; and the former receives a cork, in which the emission nozzle—a glass tube, half an inch in diameter—is inserted. The emission nozzle can be closed, while fitting up, with an easily removable cork ; all the other joints are to be warmed and plastered up water-tight with a cement of mixed gutta-percha and pitch. It only remains to place the tin box in position in front of the lantern (the larger aperture abutting against the lens tube), and to provide a supply of water, and a receptacle for the "cascade." Different colours can be given to the illumination, by inserting slides of coloured glass in the lantern stage. It would also be found advantageous to employ a small concave lens, before

the condenser, so as to parallelise the beam of light, as a pencil of, say half-an-inch diameter.

QUERIES.

Replies to the following Queries must reach the Office by Monday at latest; and those selected will be published in the issue after next.

31.—Is it a fact that plants thrive better in a frame or greenhouse that is glazed with blue or violet glass, so as to filter out all but the chemically active rays of light ?

32.—What is the meaning of the term "one man power," as applied to small gas engines ?

33.—Is there any chemical test by which living protoplasm can be recognised, and distinguished from dead matter ?

34.—Setting aside all astronomical observations, what is the simplest proof of the rotation of the earth ?

35.—What is the upper limit of frequency, beyond which sounds cannot be distinguished by the ear ?

36.—What is the simplest illustration of the principle, discovered by Archimedes, that all bodies immersed in liquids suffer a loss of weight equal to the weight of the liquid they displace ?

THE KNEE FEMININE.

The difference of weight in the brains of men and women has long been a source of deep interest to all who discourse of equality and rights. Those extra ounces remain more or less a stumbling block to the unwary. Metaphysical justice refuses to regard them other than iniquitous. Yet certain structural differences escape such close scrutiny, notably that of the knee.

The structure of the knee feminine constitutes in itself a permanent disability for many masculine pursuits. The knee joint in women is a sexual characteristic, as Dr. Ely Van de Warker long ago pointed out. Viewed in front and extended, the joint in but slight degree intercepts the gradual taper into the leg. Viewed in a semiflexed position, the joint forms a smooth, ovate spheroid. The reason of this lies in the smallness of the patella in front and the narrowness of the articular surfaces of the tibia and femur, and which in man form the lateral prominences, and this is much more perfect as part of a sustaining column. Muscles designed to keep the body fixed upon the thighs in an erect position labour under the disadvantage of shortness of purchase, owing to the short distance—compared to that of man—between the crest of the ilium and the great trochanter. A man has a much longer purchase in the leverage existing between the trunk and extremities than a woman. The feminine foot, comparatively speaking, is less able to sustain weight than that of man, owing to its shortness and the more delicate structure of the tarsus and the metatarsus.

Women are not well constructed to stand many hours consecutively and every day. It is safe to affirm that they have instinctively avoided certain fields of skilled labour on purely anatomical grounds, in which the smaller quantity of brain substance proves less an adverse factor than the shallow pelvis, the peculiarity of the knee, and the delicate nature of the foot. These, as parts of a sustaining column, undeniably leave something to be desired. Even the right to vote would not confer on womankind the right to be soldiers. Equality, it appears, is quite as much an affair of the knee as of brains.

SOCIAL SCIENCE.

Friendship.

Friendship and vice can never exist together ; therefore a vicious person never believes in friendship. His only view of life is sensual and selfish. People say that they do not believe such a thing exists as a noble, pure, manly affection of two hearts. We wish they had less excuse for their cynical assertions ; but the truth is human nature has in it magnificient powers for grand emotions and grand deeds. It has been slow to develop them, but, age by age, the higher races have worked out higher ideas, higher emotions, and purer ideals. Individuals are not all able to pick up the best conceptions of the race or age and realise them ; but some individuals do. The dirt-eater must not be quite so sure that there is nothing outside his horizon. Let him stand up once in awhile on a hillock of faith in other folks, or, better yet, disbelief in his own omniscience. Still it stands true that friendship is of so rarely fine a grain that it cannot be a common possession. Not every man can be a friend, although every man may be friendly. We shall not go far through mid-life before we see that we do not make a deep impression on many people. They smile as we meet, and are not loth to do us a kindly turn, but that one on whom we stamp ourselves inerasibly is met but half-a-dozen times in life. Unfortunately we are sure not to find this out until we have lost the chance of bringing out the negative into a perfect positive in one or more cases.

Then there are a few who are loved too easily. Every one is pleased with them. Such a man is likely never to learn the better qualities of friendship. What are these ? First of all, one must know that it is better to love than to be loved. Until you learn that you are sure of one failure or the other, either you will let love come without appreciating it, or you will do nothing at all to make your natural loveliness true worthiness, and lose your power to please. You must positively learn that the most delicious sentiment is to please others. The emotion is not difficult to understand. It is not much unlike the pride and pleasure of an artist in bestowing his genius on a panel or on a canvas. To make one happy is to create a beautiful sunset. Our happiness follows in looking at the loveliness we have created. There is nothing in the world so beautiful as a happy face, provided it be not too continuously happy. No one can be always happy. There must be the strong background of grief and unfilled desire. It is easy to spoil the most lovable friend by doing too much. We must not ward off from him all cares and pains. If we do for him continuously we become selfishly benevolent, and he will become selfishly recipient. The worst wreck is a charming person who forms the habit of receiving and not of giving. By and by he loses the sensitiveness of appreciation. He loses the knack of gratitude. He does not know the value of sweet words and gentle graces as returns for what he gets. He loses responsibility for others' happiness. Still we think it true that nature had some to love and some to be loved, and others, indeed, to be unhappy because their love is not appreciated or reciprocated. The cure for that is to change the character of our affection. There must be more of admiration and less of passion. What right has a man to claim that every one who seems adorable to him shall in turn select him as peculiarly valuable from his point of vision. Is it not something like a rejected manuscript ? The editor gives barely a glance at it. He selects what he needs and declines the rest. There are too many for their good qualities to be recognised. The finest literary work is frequently sent back before finding a publisher. The man

refused is like one of these manuscripts. He is not slighted, not rejected—simply declined with thanks. If we should happen to see some one from a slightly different angle, the chances would be in favour of quite a different relationship. A very beautiful and winning person has a superfluity of admirers. It is on the whole very unfortunate to be a charmer. A certain amount of all-round fine qualities is, however, desirable

If you would have a friendship, it must be based first of all on entire truth. There is nothing a lover resents more than a shade of deceit. He will not consent that you should befool him. It is not so much perfection that he desires, but that you shall not pretend to be what in reality you are not. If ever he detects you in a fraud, he is sure suddenly to cry out in his soul: "What! he is not what I supposed! I loved something else, something that was not, and I do not love that which is!" and your friend is lost. As a rule, friendship is not exciting. It is a mistake to believe it to be so. It requires only that there shall be no veneering. On the contrary, there is much probability that our very faults will be loved, and those who should improve us will rather encourage our frailties. But do you pretend to be a model when you are not, and hypocrisy ends the charm at once. We do not quite understand why it is that of all men a liar in words, or what is the same thing, a liar in character, should be most despised; but it is true that a thief is more thought of than a false man. We will not be cheated, and we know no more about it. We will give you a handful of our coin, but we will not let you swindle from us a sixpence. Pretence is hollowness and vanity; it is sure, sooner or later, to be detected. It is impossible for long, to pass for more than we are. It is, therefore, most important to be something. If one-tenth the effort were put to the task of becoming, that is put to the task of appearing, there would be no trouble in holding our friends. To have loved a cheat creates indignation, and the end is worse than had we no friends at all. If you lack a quality which your friends imagine you to possess, do not undeceive them rashly, but let it be your effort to attain the quality.

There is this in friendship, that one can do more for the sake of another than for himself. In this way loving wisely is a marvellous moral agency. A fine nature will not lose its love if it can help it. But still stronger is the desire not to injure a beautiful soul by any fault of our own. If you would save a man, give him a fine friend, and bid him care for his nobility and purity. We mostly influence each other not by words, but by presence. A wholesome, sincere body and soul are felt, not heard.

Why should one care altogether to be good for his own salvation? For his own sake he might care to be a utilitarian and take half his chances with the divine; could dip into indulgences of a doubtful sort, and experiment with pleasures; but for his friend's sake he will chasten himself, and for the world will not that he should look down, or be less than his best. This is the glory of friendship, that it sees another always as the one for whom the gods have toiled. If we are true to him we toil with the gods.

Professor von Pettenkofer has been studying the Iser River, which flows through Munich, carrying the city's sewage. He says that five miles below the city there is not a trace of the pollution which finds its way into the river. Some observers have thought that the self-purification of rivers is due to deposition of sediment. Dr. von Pettenkofer, however, maintains that the real agent at work in purifying the Iser River is the oxygen of the air which is absorbed by or dissolved in the water.

WHY WE WEEP.

No object has yielded more poetry than that of tears. The statement often made that insane persons do not shed tears is not all true, but there is some truth in it. Dr. Richardson tells us (in the *Asclepiad*) he has seen the insane weeping, but he admits that on visiting the wards of great asylums there is a remarkable absence of weeping in comparison with the noise, irritation, and wandering of intellect that is forced on the attention. He has also known a sane person who became insane, owing to a great calamity of grief, overwhelmed with weeping while the sanity remained, but perfectly and persistently tearless when the insanity was manifested, a result that may appear natural when the physiology of weeping is properly understood.

Tears are the result of a nervous storm in the central nervous system, under which there is such a change in the vascular terminals of the tear-secreting glands that excretion of water from the glands is profuse. Some excretion is always in process in order that the surface of the eye may be laved and cleared of foreign matters which may come in contact with it; but the controlling centre is at a distance. As the muscular power that extends or flexes a finger is at a distance from the part moved, so the excitement to tears is from an irritation in a distant nervous centre, and is removed when the nervous centre is either soothed or exhausted. The persons who weep say that tears afford relief. Nothing is more perfectly true, nothing more clear when the facts are understood. The relief comes, not from the mere escape of tears, which is only a symptom, but from the cessation of the storm in the nervous chain. If the storm be calmed by soothing measures, as when we soothe a child that is weeping from fear, annoyance, or injury, we quiet the nervous centres, upon which the effect ceases. In children the soothing method succeeds, and sometimes it succeeds in adults, although in adults the cessation of tears is more commonly due to actual exhaustion following a period of nervous activity. In grief, the afflicted weep until they can weep no more; then they become calm, or, like children, cry themselves to sleep. Thus tears indicate relief, and that the nervous system has fallen into the repose of weariness. Persons subjected to many and repeated griefs shed in time fewer tears, and the aged compared with the younger are almost tearless. The poor insane patient who ceases to weep becomes griefless; under the continued excitement the grief centre falls or dies. If this were not the case tears would flow in such a person so long as life lasted. Tears have their value in the life of mankind; they are of value not as tears, although their actual flow gives relief, but as signs that the grief centres are being relieved of their sensibility, and that the nervous organisation is being fitted to bear up against sorrow.

Respecting the nervous excitation which calls forth tears, I have noticed (says Dr. Richardson) how little it is due to physical pain. It is called forth by fear, by anxiety, by affection, by grief, but not even by pain extending to agony. In the days preceding the use of anæsthetics I have seen patients who were undergoing surgical operation faint; I have heard them cry out and scream until they have made the bystanders sick and pale, but they rarely, if ever, shed tears. The parturient woman in the acme of her "great pain and peril" may suffer the extremest physical agony, under which her cries are piercing, but she rarely sheds tears. Indeed, I never recollect seeing the most nervous of her class, under such circumstances, shedding a tear.

Strangely, however, during the sleep induced by an anæsthetic like chloroform or ether, I have seen profuse tears, not from suffering, but from some emotional dream induced by the narcotic.

A very slight emotional disturbance will induce the nervous irritation leading to tears in susceptible subjects, and this although the catastrophe has nothing to do, intrinsically, with the person affected. Hence the commotion of tears conjured up in a play. Hamlet, it will be remembered, seizes aptly this point when the player weeps. "What's Hecuba to him, or he to Hecuba?" Of course nothing, yet the player weeps, and maybe the audience weeps with the player. By art another remembrance may be used to call forth tears on the proper occasion. A well-known player was asked how he managed to weep when he willed. He replied, "I call up the remembrance of my dear father, who is dead." On the other hand, anything that produces diversion of mind, when the disturbance is not severe, may keep back the outbreak. John Hunter tells us that once when he went to the play to see Mrs. Siddons perform, in a moving exposition of her great powers, he could not join the rest of the house in their tears "because he had forgotten his pocket-handkerchief." In these facts there is nothing incompatible, because the more intense the nervous vibrations the more easy is the diversion of impulse from one centre to another.

As a rule, the escape, and free escape, of tears, relieves the heart, and saves the body from the shock of grief. Tears are the natural outlets of emotional tension. But there are exceptions to this rule, and I have more than once seen uncontrollable weeping followed by serious systemic disturbance, affecting principally the heart and circulation. I have known intermittency of the heart induced in this way, and assume the most serious character.

Change of scene, mental diversion, and outdoor life are the best remedies for the tearful, but an opiate judiciously prescribed is often the sovereign remedy. Other narcotics are injurious. Alcohol, so often resorted to, is fearfully injurious. It disturbs and unbalances the nervous system, keeps up a maudlin and pitiful sentimentality, and sustains the evil. Alcohol is the mother of sorrow. There are other narcotics which are similar in effect, notably chloral; but an opiate given at night-time, under necessity, not only soothes, but controls, and when prescribed so that the use of it shall not pass into habit, is a divine remedy.

It is one of the most curious of natural phenomena that mere imagination can excite the nervous system into the production of tears, without any external aid or reflex. The readers of a pathetic chapter of a fiction may weep over the pages without wonder, because the cause of tears has been raised before the mind; but is it not strange that the writer who made the fiction may be enforced to weep over it, and cannot, in fact, expect anyone else to weep over it unless he is himself affected by the picture he has drawn? Such facts place mind or the immaterial essence of humanity over and above, and over and preceding, our material nature and all its functions. They lead us to the suspicion that we might exist, think, and feel, without this mortal coil at all; or, as if, at best, the mortal coil were nothing more than an instrument, doing the bidding of the *ego*, clumsily or refinedly, according to its form, and no more; as if there might be material forms of finer build; angelic forms, as the old books have it, amongst whom tears are unknown.

I have often wondered whether the lower animals shed tears as men, and women, and children do? It is in the order of physiology to suppose the every animal that secretes a fluid for the laving of the fore part of the eyeball might, under emotion, throw out an excess of secretion, and shed tears; and I have often heard sympathetic people and children say of animals they were fond of, that such animals wept on the loss of those to whom they were attached, on deprivation of some pleasure, or on receipt of punishment. This statement is made most frequently in regard to dogs, but I could never, in my own observation, arrive at evidence sufficient to confirm it. Animals cry men weep, would be my interpretation of the argument; and well it is so, for if animals wept at the harsh treatment they are subjected to by nature, as well as man, there would soon be none to weep. That some of them have emotions and moments of sorrow cannot be doubted; but they have no continued memory of the emotion—no recurring pictures that recall it. They forget even their offspring after the briefest periods, and they do not weep from physical pain. The picture of the tear in the eye of the hunted deer is pathetic, and by the reflex may make some weep. But the tear is the sweat of fatigue, not the sign of emotion.

As tears are secreted by glands which lie between their nervous centre and the mucous surface of the eyeball; as they have two functions or duties—one the function of relieving nervous tension, the other of laving the eyeball—so these functions may be called into overaction by internal nervous impulses or vibrations, and by external excitations or what are sometimes called reflex actions. The first is seen in the act of weeping under emotion, the vibration starting in the nervous centres, and extending to the gland from behind, urging it to action; the second is seen in the act of "shedding into the eye," and the vibration extends from the mucous surface back to the gland, exciting it to action and causing emotionless tears. In these ways tears afford a good illustration of the mode in which the nervous fibres are capable of conveying to a secreting organ exciting impulses from both sides of a gland lying in their course, and having in connection with it afferent and efferent communications. In both cases the exciting impulse is a vibration; and as when the impulse sets forth from a mere external irritation, as from a particle of dust on the conjunctiva, the effect is in the truest sense mechanical, so, probably, in the case of the emotional irritation, which calls forth tears, the process is as purely mechanical.

In the human animal tears are most easily wrought where the sympathetic nervous system is most developed and most impressionable, and when the three great emotions—fear, grief, and joy—are most active. Hence women are generally more given to tears than men, and under the peculiar state called hysteria, in which the nervous system is at highest tension, are often seen moved to tears by the three emotions, in turn, during one paroxysm.

It has been a matter for discussion why tears are always being secreted in health for the lubrication and laving of the eyeball. That this constant process is active is shown by the copious loss of tears over the cheek whenever the lachrymal duct, by which the secretion is naturally borne away from the conjunctival surface to the nasal cavity, and so to the throat, is closed up. But what keeps up the secretion? I suspect the small trace of saline substance that is present in the tears is the cause. The salt keeps up just a sufficient irritation to give an impulse back to the gland, a reflex, sufficient to sustain the necessary function. During sleep, when the eyes are closed, and there is little evaporation from the conjunctival surface, this irritation will be subduced, and tears will cease like other functions. So sleep cures tears, as it "knits up the ravelled sleeve of care."

ELECTRICITY UP TO DATE.

(*Continued from p. 265.*)

Turning now to the stand occupied by the Maquay Electric Light Syndicate, Limited, at the Electrical Exhibition in the Crystal Palace, we find a very different system of producing electricity from that which first attracted our attention. The current for lighting the Maquay lamps is obtained by one of the oldest and simplest of processes, and at the same time one that is undoubtedly, in some respects, the safest for domestic use. This method involves merely the chemical action of an "exciting liquid" upon plates of zinc. It is an illustration of the indestructibility of force. A piece of either coal or zinc possesses, potentially, a great amount of chemical energy; and when, by suitable means, this energy is evoked it may take any form—the form of light, heat, electricity, or material motion, or all of these together, according to the conditions in which the active substances are placed. When coal is burned as in a steam engine, such energy as it is capable of liberating takes, first, the form of heat. This heat is converted, by the agency of boiler and mechanism, into the energy of motion. Thus the momentum of the engine disappears in turn, and a flow of electricity emanates from the coils of the dynamos. How much more simple (at least, from a practical point of view) is the transformation taking place in Maquay's battersy. Here is no heat, or practically none, no noise and friction. The plates of zinc are slowly acted on and liquified, and as they liquify a mild and steady current of electricity flows in the circuit. We have examined the construction of this primary battery and can certify its excellence. The salts and the zinc plates for charging are sold at a low price, and the pamphlets issued by the Maquay Syndicate, showing the cost of medical, experimental, domestic, and other applications of the battery, are interesting reading.

The next on our list of important exhibits is the reversible cell manufactured by Messrs. Cathcart, Peto, and Radford. This is a development of the celebrated storage battery. It is a little ebonite case with rounded edges, shaped to fit the pocket. Within the sealed-up case are plates of lead compounds, immersed in an exciting liquid. But here the plates are not dissolved. Electric power results from a mere surface action, and when this action has proceeded to that point at which the efficiency of the battery is exhausted, it is possible by sending through it a current of opposite direction, to reverse all the chemical changes that have taken place, and to restore both the solution and the plates to their original condition. It is as if the zinc which is dissolved in the Maquay battery could be electroplated back into the solid form again, so as to renew all the original activity of that galvanic cell. The electro plating, or, as it is more properly termed, the electrolytic action that takes place in Messrs. Cathcart, Peto, and Radford's battery when a reverse current is passed through it, is what is commonly called the storage of electricity. To speak of the force that is here *stored* as electricity is hardly scientific, but we must let that pass, however, and describe the practical applications of the battery. One of the most useful of them is to electric lighting in gas retorts, powder magazines, etc., where common candles, even inclosed in lanterns, are a highly dangerous source of illumination. Three or more of the storage batteries can, however, be fixed in a body belt and serve to light a glow lamp which, properly mounted, might be immersed with safety in a cask of benzoline. Another application of the storage batteries is to the purposes of medical electricians. Thus a physician or surgeon, if needing a supply of electricity for any of the varied uses to which the current is now devoted in the healing arts, will find the storage cells we speak of to be a source at once light, clean, and economical. The cells are also used by workmen for testing the connections, etc., in telephones and in telegraph and other cables. But the purpose to which these cells have been most largely applied thus far is lighting fairy lamps. These tiny lamps—smaller than peas—are used in artificial jewellery for ball room and stage effects, and they are capable of lighting up even "paste stones" in scarf pins, hair ornaments, etc., with a brilliancy that must be seen to be appreciated. Some of the stage effects of fairy lamps can be seen at the Crystal Palace pantomime. Both lamps and batteries are supplied at low rates by Messrs. Cathcart, Peto, and Radford, and their price lists should be in the hands of all who are interested in scenic art. Bicycle, miners', table, and piano lamps are also exhibited by the firm; these lamps being mounted as a rule with storage batteries complete. Of course, it must not be forgotten that these little batteries are useless without the means of charging them, but, given a source of electric power—whether primary battery, dynamo machine, thermopile, or what not, and such portable secondary batteries—they constitute a method for "tapping" it of unparalleled convenience. We find, at the same stand, large mirrors of a foot and upwards in diameter, resembling in shape the bijou reflectors with which electric jewellery is so plentifully provided. We are told that these large mirrors are for the purpose of electric light projection, and that they are the only examples of such mirrors, shown as a special product of manufacture, that are to be found in the Electrical Exhibition. Electric "search lights" to be projected by such mirrors can now be made up to 50,000 candle power. Imagine the effect of such a light in projecting pictures by the magic lantern! We shall have more to say upon this subject by-and-bye. Electric accumulators, or storage batteries, of the largest size are usually of the E.P.S. type. These are bulky and heavy articles, used solely for equalising the currents of large dynamo electric machines. They absorb excess and compensate deficiencies of power, thus rendering both arc and incandescent lighting steadier, and adding to the lifetime of the glow lamps. Storage batteries for tram-car propulsion and for ship and railway lighting are also exhibited by the Electric Power Storage Co., and are of the greatest interest to those practically connected with electric work.

Last, but by no means least, the splendid display of art metal work for electric lighting should be seen. Messrs. Benham and Froud's exhibits are fully lighted in the evening, and they prove, by the unusually soft and agreeable quality of the light—diffused and regulated by highly ornamental shades,—how verymuch the progress of electricity, as a factor in domestic lighting, might be advanced, if those who designed the installations were always possessed of some artistic taste. The metal work embodying Messrs. Benham and Froud's designs is, as usual, beyond praise. Some electrically lighted church fittings are also shown; and these are also unquestionably "up to date."

THE work of searching for the affinities of great groups is declared by Prof. Coulter to be the crying need of systematic botany. There is danger of magnifying the importance of certain periods or organs in indicating affinities. For the best and most permanent results of systematic botany, it should take into account development at every period and of every organ, and so obtain a mass of cumulative evidence for safe generalisation.

CAN RAILWAY ACCIDENTS BE PREVENTED?

The long list of railway collisions which have taken place of late in many parts of the country, has aroused a great deal of indignation against the management of the systems that suffered the misfortune. The manager of an important line is reported to have said: "Just as long as railroads are conducted there will be accidents on them. Only the risk of disaster can be minimised." In the main he is right in the assertion; but it seems, according to an electrical engineer, that no system of block *signals* will ever bring that risk to a minimum such as all travellers look for. Even the so-called "absolute" block signal system will have its errors and misunderstandings, for *humanum est errare*.

The block signal system is a good thing in all its various forms, but it does not escape from dependence upon human intelligence, brains must be its fountain-head and brains and fidelity to duty must extend throughout every detail of practice. Human error cannot be eradicated, and both head and rear collisions are possible and do occur and will recur, but with diminishing risk as the block signal system is improved. The system is an old one, and never amounted to much till our universal benefactor, electricity, was brought in play. But even now the wires can pulsate as well with a misconstrued or carelessly disastrous instruction as they can throb with the truth. Signals can be displayed and fog, rain, snow or defective vision will hurl a train to destruction. Trains must and will be operated on the permissive system, or long and unendurable delays will ensue at times, and the careful management causing such delays will receive the unending maledictions of the very travellers whose lives would perhaps be saved by the delay. Signals will be mistaken in spite of everything. With a proper outfit all collisions of trains on the same line *can be absolutely prevented*, whether from the front or rear. This seems, perhaps, strong language, but, our electrical engineer thinks any practical electrician will confirm it after getting the idea. It is not patented, and if lives could be saved, he will be happy to see it adopted as a practical adjunct to the block signal system for the control of fast passenger trains on our railways.

Its simplest application would be in protecting a train which stops for repairs or other cause out on the line. Imagine every passenger locomotive fitted with a powerful but inexpensive electromagnet adapted, on passage of current, *to close the throttle valve*, and another smaller magnet which, at the same instant, would operate a special valve in the brake pipe and set the system for an emergency stop. Is it not plain if a train so equipped were thundering along at a mile a minute and the energising current were sent through these magnets, steam would be instantly shut off, and the air brakes applied all over the train and all brought to a standstill? Yes, even if the engineer were holding the throttle lever, or were asleep, or had become disabled. And, further, if the energising current were projected from the train already standing on the track ahead, how could a collision occur? The sending of current from the stationary train would be very simple, and the devices should not prove a great expense. Every locomotive would be fitted with a very small steam engine, driving a very small dynamo, and the two magnets already mentioned. The throttle of the little engine could be boxed against access, and arranged in connection with the main throttle, so that when the engineer of a train shuts off steam to stop his train, the small throttle is by that very act opened, and the little engine and dynamo start up without the exercise of any human intelligence or memory whatever. A most inexpensive circuit would be a small oak stringer, laid along and spiked to the cross ties about the centre, and surmounted by a small flat copper strip laid in continuous lengths of, say, one-half mile, each length being separated entirely from that in front by a gap of, say, one foot. The other side of the circuit would consist of one or both rails. Each locomotive circuit would terminate at one end in the wheels, as in an electric street railway system, and at the other end in a brush or trolley riding on the copper strip, but insulated from the metal running gear of the locomotive. The little dynamo would be shunt or compound wound. The half-mile lengths of copper strip would constitute the "blocks."

The result of such a system would be that the moment an engineer shuts off steam preparatory to a stop anywhere on the railway, his dynamo, would instantly start into action and become fully excited by the time the train stopped. Then the instant a coming train reached the end of that block, its magnet and dynamo circuit would complete the circuit for the dynamo on the stationary train, and the approaching train would be automatically stopped at a safe distance. Every train would thus constitute its own safety system as a last resort, and even if the engineer of the second train failed to see a danger signal, or misunderstood it, or the signalman displayed a wrong signal (and these things will happen) the approaching train would be stopped in spite of its own crew. Many modifications and ramifications are possible to meet every objection. A 100 volt dynamo of two ampere capacity would suffice for all conditions of weather, and a one-third horse-power engine would drive it. Both could be put in a box on or under the footboard, similarly to the air pump, and not be in the way.

THE WAGGING OF THE TAIL.

Prof. Eimer, in his work on Organic Evolution, is not able to explain why the dogs of Constantinople erect the tail and carry it upright, while the ancestral wolf and the jackal carry it hanging down. Dr. Joseph L. Hancock suggests, in the American *Naturalist*, that the reason may be found in the fact that as the dog becomes domesticated it is prone to use the tail as an organ for expressing mental states—wagging it when pleased, dropping it between the legs when disappointed or frightened. The ancestral wolf carries it hanging down, because in that position it is less conspicuous and better eludes detection. A family of wolves playing together undisturbed occasionally carry their tails curled upward. By degrees the tail acquires naturally the upright position as a result of coincident evolution of the mind of the wolf by domestication and of the slow adaptation of the appendage as an organ of expression. The cessation of natural selection in the domestic dog would give the tail greater freedom of motion without detriment to life; and artificial selection modifies it into various shapes.

The Missouri River to the Gulf of Mexico, which many geographers contend should be called one river, is about 4,200 miles long. Reckoned thus, the Missouri would be the longest river in the world. To its junction with the Mississippi the Missouri is 2,980 miles long. The Nile must be about 4,100 miles long if the source be where Stanley says it is. Emin Pasha has recently put the source at another place, which is somewhere near 4,000 miles from its mouth. In the old surveys, when the exact source could only be guessed at, the length of the river was estimated at about 3,000 miles. The figures of length of the Amazon range between 3,600 and 3,900. These are the only rivers that are 3,000 miles long or upward.

HOW TO FIGHT BACTERIA.

The whole philosophy of medical science has of late been subverted through the gradual discovery of the extensive species of minute beings called bacteria—the lowest order of beings known to exist. They were once believed to be the product of a *generatio æquivoca*—of spontaneous generation—until it was made evident by Pasteur that they are generated *ex ovo*—from the egg. Philosophers have, however, then subsequently not abandoned faith in spontaneous generation, from the original elements upward, but have put the bacteria up as a rather composite race of beings, made up from many millions of molecules, and established a belief in a class of organic beings as progenitors, as it were, of the bacteria, which beings are said to be many times simpler in their composition and smaller than are the latter, and so minute in size that they will for ever be hidden from human sight. All diseases and ailments of the human system are, said Mr. Frederick Baumann, in a most interesting paper that recently appeared in the *Building World*, owing to encroachments thereon by bacteria, as destroyers of blood and tissue.

Some twenty-five years ago Professor Naegeli mentioned some very interesting experiments as to the life of the lowest orders of fungi, of which our bacteria are the lowest yet. He prepared a proper neutral nourishing fluid, and put therein the seeds of mould fungi, fermenting fungi, and bacteria. The result was that the latter exclusively went on to multiply at the expense of the nourishing fluid, so that not a trace of the other two kinds of fungi could be found. He then added 1 per cent. of tartaric acid to a fresh dish of nourishing fluid. The result now was that the fermenting fungi had the field to themselves exclusively. A third experiment, with 5 per cent. of the acid added to the fluid, gave the field to the mould fungi. Singly, each kind of fungi would grow in either kind of nourishing fluid, but in competition with each other the field was conquered by one kind exclusively.

Arguing from this fact, Naegeli justly asserts that the blood corpuscles, as principals within their nourishing fluid, ever prevent the growth therein of other fungi, which are constantly inhaled with the air, thus coming in direct contact with the blood of the lungs. The blood corpuscles ever do this so far as they are in sound condition. But, alas! they are often weak and often subject to debilitating effects, so that the foreign fungi get a chance to grow and multiply, so rapidly, indeed—doubling their number within every few minutes—that within a few hours the blood's life, and therewith the life of the being, may be destroyed.

Within the child there flows and grows the blood of its parents, and all the latter's ills and ailments that human flesh is heir to, accompany the child. The German student expresses this in the jocular statement that every man "should be most careful in the selection of his parents."

A birthplace of bacteria is below the ground, nearest the level of ground water. As the water recedes, the fungi get dry, and slowly rise with the ascending air current to the surface and into the atmosphere, there to be, by chance, inhaled. Assuming a grain of fine sand to be $\frac{1}{200}$ of an inch in diameter, the number of grains per cubic inch is 8 millions; further, assuming the interstices between grains at one-fourth, we may safely count 32 millions of interstices as taking up the entire space of a cubic inch. A single interstice may thus contain thirty grains of sand dust=600 blood corpuscles=24,000 microbes. A single microbe of medium size, may, therefore, very conveniently ascend within a body of even the finest sand, within the pores of rock, of brick, mortar, and concrete. It finds no sort of impediment in any dry substance excepting dense clay, so far as it is not wholly dry.

Such clay protects, as is substantiated by the following account of Dr. Pohl: A country gentleman had on his estate seven one-story houses inhabited by labourers. These houses were dilapidated and dirty. Their floors were a sort of concrete, made of clay. The houses were doomed to be destroyed, to make room for commodious tenements of a better class. At a time when cholera visited the place, five of the houses had been renewed with floors raised from the ground, which had been deprived of the layer of clay; two were in their previous condition. The disease laid up 18 of the inmates of the new and improved, ostensibly far more sanitary, houses, and none at all of the two rotten and dirty houses. The result could only be attributed to the fact that the clay floors had effectually prevented any preparatory disease germs to rise within those houses.

Mr. Baumann further tells us that bacteria are at all hours generated in the soil under our very homes, they rise; and are inhaled by us as the inmates. Among them there may at any time be some of the kind which cause disease, which might or might not grow at the expense of our blood, as circumstances beyond human control would govern. The upward current, which brings them to us, is augmented in winter, as we well know, by the reverse of temperatures. Where human well-being and life are considered worth anything, there the architect of the present day should, without fail, pay due attention to such construction of a residence building as would fairly warrant a protection against all ascending air currents ever present under its floors and in its walls. The task is neither difficult nor expensive, as we shall see, and no excuse can effectively be offered on this score.

Common materials most likely to be proof against penetration of microbes are: asphaltum, glass, and pitch tar. The asphaltum to be had in form of pressed plates. All these materials can be most readily had and employed. Asphaltum or glass, in two layers on proper mortar, to be put in all walls at the level of lowest floor. Asphaltum also to be put against exterior walls, terminating below lower water table. Concrete, with level surface, established on the entire ground, to be covered with a coat of pitch tar and tarred felting, which may be repeated once or twice, to be lastly covered with a proper layer of finish concrete. Where wooden floors are required, the finish concrete may contain the required sleepers. Where desired, a further protection can be had by spreading a sheet of lead under the furnace stand prior to making the last concrete. Even the entire surface of basement may thus be advantageously covered, where expense is no objection.

These arrangements, carefully executed, are unquestionably calculated to produce the nearest positive impregnability of floor and walls of a house, though we must conceive it as next to impossible to give absolute evidence as to such effect. We must rest our assurances on the degree of impregnability of the substances employed and on the accurate manner of their employment. The arrangement excludes the use of iron sewers and requires all water supply pipes to be suspended from the basement ceiling. Return pipes of a steam heater, and cold air ducts, must likewise be thus suspended. Iron sewer pipes are objectionable for several reasons. Iron is a bad material to be put under ground. It decays. The decay is augmented by the acids of the liquids within the pipes, and the flow is impeded by rust. Arrangements for cleansing are, therefore, provided at short intervals. Earthen sewers, on the other hand, if well made, are of the most enduring

material within our mechanical province, and should not be rejected because they are generally so bunglingly applied by our mechanics. Good sewering requires the excavation of all trenches at one time, and a concave concrete foundation on a gradual and even pitch for all sewers. The sections should be laid in mortar of Portland cement, and connected by means of metallic rings, which will insure permaneney. The receiving ends should be fully turned up, and have a socket in which is fitted an iron member receiving the soil or the waste pipe, both being provided with a tight slip joint. The joints within the socket to be tightened with a mixture of asphaltum and sulphur. Provisions thus properly made, with due care and foresight, are unquestionably calculated to secure residence buildings in a desirable measure against the encroachment of those invisible beings which are the ever-present and most persistent enemies of the human race.

PATENTS AT THE CHICAGO EXHIBITION.

A new departure will be made by the U.S. Patent Office at the World's Fair in Chicago. Hitherto, it has never attempted to go beyond an exhibition of photographs and drawings. In this instance, it will offer an elaborate and comprehensive display of models. The show will be designed to illustrate as completely and as vividly as possible the age of mechanical civilisation. It will give in concrete form a picture of the progress of invention.

The Commissioner of Patents says that the great exhibit of the Patent Office will be displayed. All that will be attempted in the Exhibition proper of his bureau will be to illustrate the processes through which those achievements have been perfected. For this purpose, groups of models will be prepared. For example, one group will represent the progress of the steam engine, beginning with the first one, which was built 150 B.C. by a Greek named Hero. It had a boiler and was able to do work by means of a shaft and belt attachment. From this primitive contrivance to the modern Corliss engine, in miniature, an interesting series will extend.

Other groups will be similarly arranged. One will represent the printing press, from Gutenberg's original invention to the rotary Hoe machine, which turns out newspapers at the rate of many thousands per hour and folds them ready for delivery. In electricity, wonders of all sorts will be illustrated by progressive series. There will be telephones dating from the primitive conception to the perfected instrument now in use. The telegraph will be introduced with the first actual instrument made by Morse, and culminating with the latest devices for printing messages at any distance with type and transmitting one's own handwriting across thousands of miles of space in a fraction of a second. The growth of the locomotive will be shown in like manner; also, that of the sewing machine, of the marvellous modern agricultural implements from primitive types; of clocks, from the water clock of ancient Babylon, and the later hour glass, etc.

Many of the models required for these groups are already in the possession of the Patent Office, but a large number will have to be constructed especially for the purpose. Manufacturers all over the country will be asked to supply specimens of their products for representing the latest developments of inventive art. The locomotive works will be requested to lend miniature models of their newest engines. Makers of agricultural tools and sewing machines will contribute the most improved specimens of their handiwork. Likewise with printing presses and everything else. Few, if any, of the mechanical models will be set working, however.

EVOLUTION OF CLOCKS AND WATCHES.

The beginning of modern clock-making may be dated from 1656, when Huygens attached the pendulum to the clock. This gave horology a place in the exact sciences such as it had not before held. The next important advance was the invention of the watch balance-spring, by Dr. Robert Hooke, of the Isle of Wight. He was the author of other valuable inventions and improvements, among them the "anchor" escapement and some ingenious tools for the making of astronomical instruments. Previous to 1691 watches had only the hour-hand. Daniel Quare, of London, added the minute-hand. Nine years later the horizontal escapement in its perfect state was made public by George Graham, F.R.S., and the device of jewelling the parts most subject to wear was introduced into England by M. Facio, of Geneva. The English Government commission on a method of finding the longitude, of which Sir Isaac Newton was a member, appointed in 1714, published the conclusion that an accurate time-keeper would furnish the best means; and an offer was made by the Government for the discovery of a method—fixed at £10,000, if by it the longitude could be defined to one degree; £15,000, if within two thirds of a degree; and £20,000, if within half a degree. John Harrison, born at Foulby, near Pontefract, in Yorkshire, in 1693, who devised the gridiron compensation pendulum, was stimulated by the offer to efforts to find a similar regulator for a watch, and devised an automatic regulator which Halley thought might prove to be of some value. He applied it to a time-keeper, which, having stood a test in a boat on the Humber, was successfully taken to Lisbon. The Board of Longitude advanced him £500. A second instrument was not satisfactory to the board; but a third won for the inventor the gold medal of the Royal Society. This instrument was sent on a long voyage to Jamaica. After being eighteen days out, a difference of more than two degrees appeared between its indications and the shipmen's calculations. Harrison insisted that his time-piece was right, and told the shipmen that, if they turned in a certain direction, they would sight a certain island the next morning—if the maps were right. They did so, and the island was seen, according to his prediction. Like results were obtained as island after island was passed. On arriving at Port Royal, after a voyage of two months, the time-keeper was five seconds slow; and on returning to England, after five months, its error was less than a minute and a quarter. Harrison was not allowed the offered reward till more sure tests were made, but was given £5,000. The watch was tested on a second voyage, with triple precautions, and Harrison was allowed £5,000 more, and promised the rest of the £20,000 when he had taught others how to make the instruments. Having fulfilled all possible conditions, he was fully paid in 1767. His time-keepers are still preserved, in charge of the Astronomers-royal, in Greenwich Observatory.

THE Museum of Natural History, of New York, has acquired a mastodon's tusk, which was lately discovered by the labourers employed in excavating the Harlem Canal, in the northern part of the city of New York. It is 4ft. long and 6in. diameter at the base. It is in a good state of preservation. It was found in the bog 16ft. below the surface, in peaty ground.

TO INVENTORS.—Anyone having a good Invention can, on applying to the Editor, "Science Siftings," obtain the advice and assistance of a well-known Patent Expert, free of charge.

INSECTS THAT GIVE LIGHT.

Fireflies have been put and are even to this day applied to come curious uses. In Santo Domingo and other West India Islands they are employed for lighting purposes, being confined in lanterns, both for going about the country at night and illumination of dwellings. By attaching one of them to each foot while travelling in the darkness they serve as a guide to the path. They are also utilised in Cuba and elsewhere for ornaments, wherewith the gowns and coiffures of ladies are adorned on festive occasions. One can read by the light which a few of these insects give. One point that may be urged in behalf of these fireflies is that they kill mosquitoes, finding in the latter their favourite prey.

The ancients were probably unacquainted with the species of fireflies which are so familiar to-day, because the most remarkable of these are peculiar to America. The great lantern flies of Southern Europe and Asia, which are sometimes called "flying glow-worms," are allied to the boat flies and water scorpions. On the other hand, the fireflies of the tropics are beetles. The latter are of sombre hue in the daytime, and it is only at night that they show their lights.

The English glow-worm is the wingless female of a winged beetle. Some suppose that the light she bears is bestowed for her protection to scare away the nightingale and other nocturnal birds. Others, however, believe that the gift of brightness is the very lure by which her foes are assisted to discover and devour her, and others again that the light serves to attract the male insect which does not itself emit light. Much speculation has been indulged in as to the nature of the glow-worm's light, which is not put out by water nor seemingly capable of giving forth any heat. It has been asserted that the light-diffusing substance contained phosphorus, but this has never been proved. Certainly it is incapable of communicating ignition to anything.

Least attractive among the insects which give light are the so-called "electric centipedes"—black crawlers with many legs, which have been likened to serpents' skeletons in miniature. They move in a snake-like fashion, forward or backward, leaving behind them a bright track of phosphoric light. However, they are most accustomed to appear in the daytime, when the illumination they afford is not visible.

ANSWERS TO CORRESPONDENTS.

Questions to which answers are desired in this column must NOT *be marked "Science Queries and Answers."*

NEMO.—Many thanks for your letter. We think, however, that the gentleman's theories have been fully exploded.

WOULD-BE DOCTOR.—You would have to go through the same course as a male student. Your private medical man would, no doubt, give you fullest details.

HERBERT SIMMONS.—Many thanks for your suggestion, which we will endeavour to adopt. Your question is hardly suitable, but your commendations are very welcome.

ENTOMOLOGIST.—We regret that we have no space for the insertion of your article.

D. HERMAN.—The moist copying paper is probably prepared by treatment with a solution of glycerine and chloride of calcium, dissolved in water.

J. B. COTTON.—To reblack the stage and diaphragm of your microscope, first clean the parts with fine emery paper. Then hang them by a fine copper wire, and soak for a couple of minutes in solution of 1 oz. of caustic potash or soda to the pint of water. Rinse in water, and dip for an instant in commercial nitric acid. Rinse again immediately, and immerse in a hot and strong solution of chloride of platinum. The chloride of platinum is very expensive, and you would probably find it cheaper to take your work to an optician than to make up the required solution.

ED. SMITH.—Unsuitable. The isolation of fluorine is difficult, if not impossible.

J. R. K.—Glow lamps burn out by reason of the fact that carbon is slightly volatile at the temperature of bright incandescence. Volatilisation does not take place quite uniformly, and the consequence is that, sooner or later, a thin place appears in the filament. At this spot, then, the resistance is highest, and the greatest heat is developed, leading to increased evaporation of carbon, and ultimate failure. In a perfect vacuum the same effects would probably take place, but not so quickly.

S. ROBINSON.—Glass or enamel letters can be fixed on glass windows by a cement composed of 1 part india-rubber and three parts mastic, dissolved in 50 parts of chloroform.

S. M.—To protect your nickel-plated bicycle from rusting, when put away for a few weeks, wrap up the bright parts, after the usual wiping and oiling process, with strips of paper that have been plastered with a mixture of 4 parts vasiline, 1 part paraffin, and 1 part powdered quicklime, warmed and stirred together.

YOUNG ASTRONOMER.—We cannot reply to anonymous communications. Send your name and address.

K. L. GORTON.—Some organic compounds used in drugs are of such a complicated character as to be very difficult of estimation by quantitative chemical analysis. In most cases, however, the compounds can be analysed completely. The "use" of a valid patent for a medicinal compound is that any chemist making and selling the compound without license from the proprietor of the patent, would render himself liable to an action for damages for infringement.

S. ROBINSON.—To join light pieces of cast iron, make a cement of wetted sulphur, mixed with half its weight of fine plumbago. Chemical combination takes place, and the liquid mass is poured on a stone slab to cool. This cement is to be applied like soft solder, the iron surface to be joined being first heated to a temperature sufficient to melt it.

BRASSWORKER.—The chemical method sometimes used for cutting thin sheet brass, consists in first cleaning the surface, then drawing a line upon it in the required direction with a strong solution of mercuric nitrate. The nitrate of mercury becomes decomposed, copper is dissolved, and an amalgum of zinc with mercury is formed, which renders the sheet so brittle as to be readily broken in the desired direction.

SURVEYOR.—Relief maps are moulded from a mixture of plaster of paris and cotton wool, with a solution of glue or gum, to which a little chrome alum has been added. The backs of such maps are usually stiffened with a layer of canvas.

NEW SUBSCRIBER.—The speed of light is 196 000 miles per second. It is supposed that waves of actinism, radiant heat, and radiant electricity are propagated through the luminiferous ether at the same rate of speed.

WOULD-BE CHEMIST.—To recognise free oxygen in chimney and other gases, you may proceed as follows:—Collect some of the gas in a test tube or graduated tube inverted in a basin of water. Bring the water within, to the same level as that without the tube, and then insert an accurately-fitting rubber cork. After noting the volume now occupied by the gas, withdraw the cork (while the open end of the tube is under water, of course) and introduce a piece of caustic potash into the tube. Cork it up again immediately, and shake for a few minutes or until the caustic soda is completely dissolved. Then remove the cork to permit readjustment of the water level. Any contraction which has taken place is due to absorption of carbonic acid. Next wrap a few grains of pyrogallic acid tightly in a single fold of paper, and introduce this similarly to the caustic potash, and so quickly as to prevent the escape of any considerable proportion of that substance. The absorption now observed, which is accompanied by blackening of the potassium pyrogallate solution, represents the amount of free oxygen in the gas under examination. With a pretty large graduated tube we have found this simple method of testing furnace or other gases to be remarkably expeditious and accurate.

HOUSEHOLDER.—The illuminating power of coal-gas is, roughly speaking, proportional to the volume per cent. of hydrocarbons absorbable in bromine that the gas contains. You can determine this by collecting some of the gas in a graduated tube, inverted over mercury contained in a pneumatic trough. Introduce a little bromine into the tube by means of a pipette and note the contraction which takes place. Bunsen's photometers can be obtained from any optician or dealer in scientific apparatus. Consult our advertising columns.

J. B.—Brown sugar is most commonly adulterated with sand. You could readily discover this by dissolving the sugar in clear water. The other materials you mention had better be purchased from a respectable tradesman, when little fear of adulteration need be entertained.

THOS. BOWKER.—Your letter is very interesting. We only regret that our limited space will prevent its publication in extenso.

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Deposit System: To facilitate the transaction of sales between strangers, the purchase-money may be deposited with us. We will acknowledge the receipt of the deposit of both parties, and hold the money until we are satisfied that the goods have been returned or the purchase satisfactorily concluded. When remitting to the Seller, or returning the deposit (if no sale be effected) the following amounts, to cover expenses, will be deducted:—For amounts under 40s., 6d.; for amounts over 40s., 1s. In the event of articles sent on approval not being returned, or notice being given to us within 4 days, the sale will be considered effected, and the purchase-money forwarded to the Vendor.

Exchange: We cannot undertake to receive or forward articles; money, therefore, to the estimated value of the exchanges should be deposited with us.

Remittances, etc.: All remittances must be made either by postal order or halfpenny stamps. Envelopes must be marked "Sale and Exchange," and addressed to the Manager, "Science Siftings," 78, Fleet Street, London, E.C.

Quarter plate camera, rapid lens, tripod, 6 plates, ruby lamp, suit learner, 5s, Jones, 12, Hughenden-terrace, Leyton-road, Stratford.

Lancaster's ¼ plate 1890 patent instantograph, with swinging back, rising front, Lancaster's patent shutter, rackwork adjustment, close folding stand, gold solution dishes, printing frame, velvet focusing cloth, 2 oz. measure glass, etc., all quite as good as new. Lowest price 27s. 6d., a great bargain. Knight, Gordon Villa, Albert-road, Tonbridge.

Whole plate mahogany sliding body studio camera, with swing back, portrait lens, 3 slides, numerous carriers, tripod, £3 lot. W., 23, Grosvenor-street, Camberwell.

Bargain. Splendid whole plate camera, tripod, and 5 double dark slides, £5 15s. Offers. Gannon, Chelmsford.

Heavy double roller rolling press, steel plate, 9 in. by 6 in., £2; good developing tent, 24 in. by 18 in., 15s. 6d.; steel rotary burnisher, whole plate, 7s. 6d.; good ruby lamp, 3s. 6d.; large wooden draining rack, take any size, 5s.; printing frames, 12 by 10, 10 by 8, 9 by 7, 8½ by 6½, 5½ plate, 2¼ plate, 7s. 6d. the lot; 1 washing tank, 2s. 6d.; 1 negative box, 50 plates, 2s. 6d.; porcelain dishes. 11 by 9, 2 9 by 7, 2 7 by 5, 2s. 6d. the lot; half plate light proof box, 2s. 6d.; or the whole of the above £4. Clarke, 12, Farquhar-road, Norwood.

Quarter plate camera, with lens, and accessories for developing, printing, and mounting. Price 40s. W. Rutter. Hallburton, Coupar, Angus, N.B.

Ten by 8 studio camera, lens, stand, etc. Price £6. Approval. 7, Risworth-road, Dewsbury.

Powerful 4 lens, suit ½ plate camera, 27s. 6d.; cost double. Thomas, Old Hall, Wellington, Shropshire.

Photographic burnisher or press wanted. Gray, 231, Stirling-road. Glasgow.

First-class ½ plate camera, lens, shutter, tripod, case, etc. Price £5 10s.; or exchange for safety. Chambers, 25, Summergate-street, Halifax.

Ross's rapid symmetrical lens, 5 by 4. What offers? Sykes, Belvedere, Weymouth.

1891 special ¼ instantograph, 3 slides, brass bound, best tripod, swift 5-4th portable and rapid paragon lenses, Thornton shutters, satchel, £8, or separately; Taylor's single lens, whole plate, 35s. E., The Croft, Braintree.

For sale, Lancaster's phantasmograph, for making lantern slides, 6s. 6d. Tweedie, 54, Hawley-square, Margate.

British birds' eggs, cheap. Lists sent. A. Buttress, Grove Rectory. Retford, Notts.

Good collection of goods for sale, with fine cedar chest, 16s., or separately; perfect. List on application. R. Clark, 66, High-street, Barnet.

Wanted, any kinds side blown birds' eggs, in clutches. Cheap for cash. Booth, 26, South Everard-street, Lynn.

Wanted, good powerful microscope, in case, complete, for beginner. For cash. W. S. Oakden, Burton-on-Trent.

Excellent monocular microscope, 2 eyepieces, 3 objectives, mechanical stage, substage. Webster condenser, mahogany case. Cost £25; price £12. On view in London. 50, Castlebar-road, Ealing.

Case drawing instruments, brass sector, in case. proportional compasses, together or separately. John Chudleigh, Newton Abbot.

For sale, ship's chronometer, 2 days, in splendid condition, good timist, no further use for it. Cost £65; price only £10, or reasonable offer. 107, Mansfield-road, Gospel Oak, London.

Good box compasses, 10 pieces. What offers? Wallis. 89, Lorrimore-road, S.E.

Pair opera, marine, and field glasses, in case, perfect, 30s., cost 110s. 367, Victoria Park-road, London.

Wanted, box sextant, by a good maker. Deposit system. Address H. C., Polaput Tamar, Launceston.

Wanted, Edison's phonograph, good. Cash or valuable exchange. Blake, St. James's, Portsea.

For sale, hand dynamo, by Dale, geod order, useful for experiments. Price 50s. Tweedie, 54, Hawley-square, Margate.

Gramophone, talking machine, large size, suitable for bazaars, can be heard by 100 people at once, with 16 loud speaking plates. Only 30s.; cost 52s. King, 2, Cornwall-road, Mile End.

Wanted, good galvanic battery. State lowest price for cash. W. S. Oakden, Burton-on-Trent.

Large cylinder, 4 large Leyden jars in case, 15s; worth double. 18. Tonning-street, Lowestoft.

Eight in. ebonite plate Wimhurst machine, quite new. Price 20s. Cannon, Woodlands, Sunny-gardens, Hendon.

Single needle telegraph, as used in Post Office, 30s.; cost £5. Falkner, Crewkerne.

Object glasses, 4 in. 3, 2, 1, ⅔, ¼, ⅛, 1-12, immersion, double non-pieces, Collins, Webster condenser, polariscope, parabolic reflector, all latest improvements, and in first-class condition. Price £50; cost £100. Tedmas, Plumtree-street, Nottingham.

Dallmeyer's 1 B lens, as new, 76s., cost 125s.; 5 by 4 tourist camera, 3 backs, case, and tripod, thorough order, 80s., cost over 8 guineas. W. Wallis, Rayleigh.

Camera and dark slide, 7¼ by 4½ (Cox, Ludgate-hill), solid mahogany, 20s. Deposit or view. Wilson, 6, Rathgar-road, Loughboro' Junction.

Giving up photography. Will sacrifice my ½ plate camera, lens, dark slide, shutter, etc., with a few plates, bromides, etc., 30s. Byrne, 6, Catherine-street, Macclesfield.

Judson's 20 cell medical battery, nearly new, metallic brush. sponge holders, 3 disc electrodes (nickel plated). List 90s.; bargain, 60s. Deposit. Chesswas, Thanet-lodge, Clifton-road, Norbiton.

Wanted, plain background, on roller, about 8 ft. square, not less, must be good and cheap. Thos. Maiden, Jackfield Ironbridge, Salop.

Wanted, ½ or ¼ photographic set. Exchange safety. 7, Dereham-road, Norwich.

What cash offers? Dolland's 12 guinea astronomical and terrestrial telescope, good condition, mahogany case, lock and key. Dixon, Bellevue, Grove-hill, Woodford.

Beautiful stuffed fox, in case, 40s.; bitterne, in case, 12s. 6d.; merlin, in case, 7s. 6d. The Priory, Yetminster, Dorset.

Lancaster's omnigraph detective camera. Cost 25s.; nearly new, 16s. Geo. Massey, 21, Elizabeth-street, Walworth.

Deerskins, 2, very large. Sent on approval. 10s. 6d. each, a bargain. McDowall. 12, Derby-street, Glasgow.

Wanted. Troughton and Sims' 14 in. dumpy level, with compass preferred, good condition. trial required; exchange 4 in. Y theodolite, or cash. Monterie, Milford, Surrey.

Medical battery, all appliances for rheumatism, etc., mahogany case. continual steady and regulating current, 30s., cost 5 guineas. Reed, 14, Manor-place, Paddington, London.

First class opera glasses, 8 lens, in case, as new, 13s. Approval. Hopkins. Stopford House, Upton Manor, Essex.

Forty-two microscope slides, in cabinet, on trays, 10s. 6d. Approval; exchange, Lintin, 170, Freedom-road, Sheffield.

Camera stand (folding cyclist's) for sale. Cost 25s.; price 10s.; good as new. Address Kingswood, Mortimer-crescent, St. John's Wood, N.W.

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LONDON: SATURDAY, FEBRUARY 27, 1892.

SCIENCE NEWS AND NOTES.

"Prove all things; hold fast that which is good."—
1 THESS. v. 21.

Instinctive Criminality

was the subject of a paper, read by Dr. S. A. K. Strahan, barrister-at-law, before the anthropological section of the British Association at the Cardiff meeting last year, and now published in pamphlet form. We referred to this subject in our last issue incidentally to Mrs. Osborne's case, but, owing to Dr. Strahan's presumed experience, it is worth while returning to the subject in order to examine his views. Not that they may be considered as conclusive, for many of his premises are open to controversy, but, as the author points out, "reformers are open to ridicule and even to abuse," although he claims that his opinions as to the proper and different treatment of habitual criminals, embodying a proposal that involves sweeping and radical changes in principles which have gone unquestioned for centuries, have been received with respectful attention. From this he concludes that his proposals are timely.

Where Crime has Arisen

from passion, poverty, or temptation, or even resulted from bad example and associations alone, Dr. Strahan does not consider it due to instinctive criminality. In the term he only comprises those individuals who take to anti-social ways by instinct or nature, and who murder, steal, lie, and cheat, not because they are impelled to do so by force of adverse circumstances, but "because they are drawn to such a course by an instinct which is born in them, which is too strong to be resisted by their weak volitional power had they the desire to resist, which they have not." There is some truth in this, and for want of an English word the Yankee expression "cussedness" might be suggested. But when Dr. Strahan gives this class as comprising "fully two-thirds of our whole criminal population, including offenders of all grades, from the murderer down to the petty thief," we must, as the *Lancet* also points out, take exception to this as an exaggeration. Probably five per cent. would be a nearer approach to the truth.

As Regards Insanity,

the prevalence of which among criminals is declared by Dr. Strahan to prevail to the extent of being forty times that of the average citizen, it is true that prison life favours this unless carefully watched, and the more highly-strung organisations are subject to it rather than the dull, instinctive criminal. The *Lancet* thinks this fact, which must be well known to the classes whence "gaol birds" are derived, ought to be an additional deterrent. This, however, does not appear to be the case. Suicide is also advanced by the author as a symptom of family degeneration as positive and grave as insanity itself. This is opposed to history and fact. In pagan times, and where the pagan spirit now lives, suicide was the refuge, and still is, of men of more than average brain power. The low cunning man is not the one usually found to commit suicide. It is far more frequent with the sensitive and highly-strung class who revolt at an animal existence and decline to accept or risk the chances of to-morrow.

The Physical Description of the Criminal

is thus summed up by Dr. Strahan: "The criminal is very closely related to the insane, especially the congenital insane, and personally he bears a strong family likeness to his near relative the idiot. In the criminal we find small, over-large, and ill-shaped heads, paralysis, squints, asymmetrical faces; deformed, shrunken, ill-developed bodies, and other abnormal conditions, large heavy jaws, outstanding ears, and a restless, animal-like or brutal expression, all of which are common characters amongst the inmates of our idiot and imbecile asylums; and as there is no beauty to be found among the inmates of such asylums, neither is there any to be discovered in our prisons, proving how well founded is that instinctive feeling of repulsion excited by the sight of the ill-favoured and deformed." Surely this cannot apply to all criminals—only to the instinctive. It is notorious that the criminal classes comprise a large proportion of individuals who, if foul within, are certainly fair without. We do not refer to chance or accidental criminals, for if an examination of our goals be made, it will be found also to apply to "habituals" and instinctive criminals.

The System of Treatment

suggested by the author is curative, not punitive, or only preventive. He proposes, "prolonged incarceration upon an indefinite sentence in an industrial penitentiary. Every judge of assize, recorder, and stipendiary magistrate should be empowered when he thought fit to send any person con-

victed before his Court to an indefinite term of incarceration in such penitentiary, provided at least three previous convictions could be proved. In this institution the plank bed and solitary confinement would be unknown. In the place of such treatment every effort would be made to improve the criminal so far as possible morally, physically, and intellectually, and from this place he would be set free on parole, only when it was thought that his anti-social instincts had become sufficiently blunted to enable him to mix with society with safety." There are some points that Dr. Strahan entirely omits to consider. Is his "instinctive criminal" the result of a freak of evolution ; is he the result of a lapse of species; or, in the course of "natural selection," is he a distinct species left behind in the advances made by the rest of mankind? Hereditary criminality is not sufficiently explanatory.

The Brain of Man

and the structure and functions of the nervous system are closely allied, so closely, in fact, as to form one system. As regards animal life, however, they do not appear to be quite so closely identified. Many interesting things may be observed in brain comparisons. In the brain of the skate, for example, the same divisions may be traced in what might be called the developmental order as exists in that of the highest animals. There is the fore-brain, the mid-brain, the hind-brain, and the medulla oblongata. Similar results are to be obtained from an inspection of the frog's brain and a brain in an embryonic state. The grey matter of the brain, which forms the nerve centres, is most developed in animals of the highest type, and in the human organ the whole surface of the brain is one convoluted grey mass. One hemisphere of a chimpanzee's brain has been shown to possess a highly complicated structure. In the frog we have the pineal gland, which Descartes thought to be the seat of the soul, but which is now known to be an invertebrate eye. The functions of certain small masses of grey matter to be found in the brain are two, viz., sight and equilibration. The optic nerve is situated close to the crura, and equilibration is subserved by the cerebellum.

What are you Thinking About?

is a very common question from one individual to another, and sometimes it is found very difficult to reply to such inquiries, and often a close analysis of the mind reveals the fact that moments spent apparently in thought have been completely blank. Why is it that when we see a person gazing fixedly for several moments at a certain point on the floor or in the street we say he or she is thinking hard upon something? Nine times in ten a person thus engaged—or disengaged—is thinking of nothing. At such times, the mind is napping and there is no thought. Probably one of oldest fads—and it seems to be nothing more—consists of persons when at such times they are asked what they are doing, saying "thinking hard!" In the large majority of cases when a person is thinking hard or intently the eye roams from one object to another and the hands and feet are moving more or less. The busiest, hardest working brain insists on taking momentary naps several times a day. Just before dropping off into one of these naps the mind commands the eye to fix itself upon some object and stay, thus usually insuring the holding of the head and probably every part of the body quiet. Then the mind catches its little nap. These little mind naps or flashes of rest may never be more than twenty seconds long, and yet they have been discovered to do the mind a wonderful amount of good, they never come to the deranged mind and it has also been discovered that the supposedly sound mind which does not take them is on the verge of insanity.

The Painlessness of Death by Hanging

is dealt with in our "Query and Answer" column this week. The *St. Petersburger Medicinische Wochenschrift* now gives a *résumé* of a paper by A. S. Ignatovski on the cause of death by hanging. He refers the rapid loss of consciousness after suspension to the retarded or arrested circulation in the brain brought about by the increased intra-cranial blood pressure. The effect of this impediment to the circulation is the same as in cerebral anæmia, for in both the nutrition of the brain suffers. It is therefore not, as Leofman teaches, an insufficient supply of blood to the brain, due to compression of the carotids, which interferes with the functional activity of the brain, but compression of the capillaries by increase of the intra-cranial pressure, which has this effect, and which occurs whilst the supply of blood remains the same, or even increases.

Rest is Essential to our Well-being,

but it is a question if we all thoroughly comprehend what is meant by rest. Change from one occupation to another is rest. It does not signify because a patient is recommended "rest" that he must go forthwith into solitude and *rust*. He may employ himself with a diverse occupation to what he has been accustomed, and thus remove the strain that has been weighing on his system, this is often—not always—the only rest that is needed. The feeling that we need rest, rest, rest, is often a fallacious one. It is action which makes muscle. The spirit of life enters into us when we take a vital part in to-day. Often we suffer from rest. A change of occupation is what we most need, as a rule, and the relief hours of an active person turn out to be very intelligent. We must rest, but we must not lose our electricity, which the will, the thought can command at all times, and which ought to be on guard like an orderly, to summon us when we should become alert. Headaches evaporate if we must exert ourselves for those we love, or we almost forget the pain, which is the same thing ; and ill temper cannot flourish unless we have idleness in which to reflect upon the motes belonging to some one else. With energy leading the way, ennui lifts from the horizon, and we see colour and distance again. There are women who labour day by day in hunger and despair. It seems as if others might labour in comfort and health, instead of sitting down to lassitude and sighs.

Bee Poison for Rheumatism

is one of the latest antidotes we have heard of. An old gentleman writes to a contemporary to the effect that he has virtually found the sting of bees an antidote to very severe rheumatic pains to which he was subject. Although seventy-four years of age, he voluntarily submitted to stinging, and found it quite efficacious. In one case two days passed after the stinging before the cure seemed to be effected, but the rheumatism almost disappeared for several months after the infliction of a stinging on the eyebrows and left hand.

The Pasteur Treatment,

in speaking of antidotes, is forcibly brought to our mind. How is it we do not hear quite so much of M. Pasteur and his reputed cure as formerly? It would be interesting to know how much of the cure—as of other similar cures—depends upon faith. There is no doubt that the faith in Pasteur brought his patients a peace and calm that saved their lives, as opposed to the frantic panic of those—who had been bitten by dogs, possibly not hydrophobic at all—who

frighten themselves to death. It is surprising how many intelligent people insist in their panic on the prompt killing of a dog which has bitten any one, on the superstition that the death of the dog will prevent hydrophobia attacking his human victim. It would be a waste of time to point out the fallacy of any such idea, because, if the dog was mad at the time of the biting, the injury would be done long before he could be killed. On the other hand, the killing of the dog adds greatly to the danger of hydrophobia following the attack, because, terrible as are the symptoms of this disease, hydrophobia in its initial stages is, as we have hinted, largely imaginary, and that is the reason of the great success of Pasteur's remedy, or rather the confidence it creates in the unfortunate victim. On exactly the same theory, if the dog is not killed, and after a few days proves conclusively that it was not mad, the sufferer's mind is eased and he ceases to worry himself into sickness by thinking about the horrible doom his Job's comforters never tire of describing. If the dog is killed at once he is sure to hear of symptoms of madness in the animal just before the attack, and if of a nervous temperament will soon worry himself into his grave. When anyone is at all nervous after being bitten it is much better to have the dog tied up and carefully watched, and in nine cases out of ten all danger from hydrophobia will soon be proved to be impossible. Madness is generally supposed to be confined to what are known as the "dog days." but only last week a patient, who was bitten by a spiteful little terrier, insisted on the animal being killed, in spite of the earnest protest of its owner.

Science Siftings of the Sea!

Grains of gold! Accumulating under the directive influence of that subtle agent electricity, *tons* of the precious metal, recoverable easily and simply from the waste waters by which our coasts are washed! Such is the glittering dream to which a paragraph in No. 4 of SCIENCE SIFTINGS has given rise. Is this dream destined to be realised? And can it be realised so easily and cheaply as to satisfy the "great expectations" by which its inception has been characterised? These questions must not be too boldly answered. There can be no doubt, however, that more method than madness is discoverable in the proposals thus far advanced. In some respects the process bears considerable resemblance to a reaction, already quite well-known, by which the copper sheathing of wooden ships receives a coating of silver from the sea. Probably gold also may have been reduced upon these copper sheets, but has been overlooked, or perhaps deposited as non-adherent powder. A chemical examination of those ships' bottoms, that have been mercurialised by "barnacle doctors," might prove most interesting to students of this subject. It is appropriate also that we should refer to the fact that gold has been electrolysed commercially, in the gold ore chlorination process, from its solution in salt brine. We refer our readers to an article appearing in another column for some interesting details relating to the amount of gold in sea water.

Mr. Nikola Tesla,

in his most interesting lecture before the Institution of Electrical Engineers, has demonstrated, among other important facts, that an electric disturbance adapted to electric lighting purposes can be conveyed through a single conducting wire, the return circuit being completed, not through the earth, not even through the air as such, but through the ether with which space is filled. Mr. Tesla has constructed a powerful dynamo machine, capable of generating 20,000 alternating pulses of electric current in a second. He has also constructed a very perfect, that is, a highly insulated induction coil; and with these two appliances he obtains, as might be expected, some very remarkable results. When the primary wire of the induction coil, or "transformer," is in circuit with the alternating current dynamo machine, a brush like discharge takes place from either secondary terminal; and this discharge, although unaccompanied by any appreciable combustion, possesses many of the characteristics of a flame. By screening the discharge from loss of heat by convective currents of air, it will be found to develop a high temperature even at the normal atmospheric pressure. But when the discharge is excited in a high vacuum, it is capable of raising a button of carbon to a condition of the brightest incandescence. There is, in some respects, a resemblance between this method of electric lighting and that discovered some years ago by Professor Crookes in his researches on "radiant matter." Both methods possess an advantage over the now common filament of incandescent carbon, by reason of the fact that, a compact button is necessarily more resistant to the disintegrating tendencies of a high temperature than any delicate filament could be. And still more so, when, as in the case in the electric glow lamp, destructive forces are intensified at the weakest points.

The Physiological Effect of the Current,

when alternating at the high rate of speed employed by Mr. Tesla, is apparently almost nil. Notwithstanding their enormous electro-motive force or "tension," these currents excite scarcely an unpleasant sensation in the human frame. This matter is, of course, one very interesting to physiologists, and we find, in a technical contemporary, the suggestion that, just as the human eye is sensitive only to electrical vibrations of a certain range of frequency, so the insensitiveness of the general nerve system of the body may begin and end at considerably lower limits.

Lighting Without Wires

is the most striking of Mr. Tesla's results. By means of his powerful apparatus, a rapidly alternating condition of etherial stresses and strains can be induced, pervading a large room, extending, that is to say, from wall to wall, between the electrodes of the current transformer, and capable of exciting luminiferous energy in a conducting medium suitably placed. In point of fact, Mr. Tesla's exhausted "lamps without wires" may be placed in almost any part of the "electrified" room without evincing any material diminution of brightness. Viewed as a practical and, perhaps, an economical, method of transmitting useful energy, these experiments are both novel and ingenious. The fundamental discovery upon which they are based is due to Hittorf, and has been worked upon by Professor J. J. Thomson. For their practical development, however, the enterprising ingenuity of Mr. Tesla, in conjunction with his keen commercial instinct, is solely responsible. There would be little difficulty in constructing a motor to convert these "static" electrical disturbances, which Mr. Tesla employs, into mechanical energy. Such a motor would be interesting, but not practically useful; and, indeed, there is as yet but little reason to predict a very early introduction even of Mr. Tesla's lighting system, as a commercial method of procedure.

BACK NUMBERS.

All back numbers of "Science Siftings" may be obtained either direct from the office, or through any respectable newsagent.

GLEANINGS OF THE GLOBE.

THERE are 208,749 railroad bridges in the United States spanning 3,213 miles.

A NEW style of bicycle is urged along by an auxiliary power imparted from the handle bar. It is used in spurting and hill climbing.

THE rudder of the French ironclad Bnennus, which was recently launched at Lorient, was 18 feet high, 13 feet wide, and weighed 17 tons.

THE deepest sounding yet made on the coast of Africa was of New Orleans, by H.M.S. "Challenger," whose 400-pound lead struck bottom at the enormous depth of 26,700 feet.

THE sewing machine is the only machinery used in the Sierra Leone Island. The colony is 103 years old and contains 50,000 people without a sawmill or any other sort of mill to do any kind of woodwork.

A VERY ingenious registering till has been introduced by Mr. C. Leni, of 377, Strand. Its chief recommendation is simplicity of construction. In addition to this it is claimed that the cost is less than half that of any registering till extant.

ACCORDING to Herr Japing, the hourly rate of water falling over Niagara Falls is 100,000,000 tons, representing 16,000,000 horse-power, and the total daily production of coal in the world would just about suffice to pump the water back again.

THE depth at which some of the Belgian coal mines are worked is something prodigious. In a pit at Flenu the work is now done at 3,700 feet; in a pit at Fremerin at 2,800 feet, and in the St. André pit at Montigny-sur-Sambre at 3,000 feet.

THAT comparatively new product, cocoa butter was at first said to be prepared from the milk of the cocoanuts, but as a matter of fact it is produced from the cocoanut oil, by treatment with alcohol and animal charcoal, which removes the rancid flavour and makes the butter white.

THE benefit of the electric light in the factories of Germany is said to have been so marked that it is proposed to make its use compulsory in all works where artificial light is employed during working hours. The incandescent lamp is rapidly coming into universal use in the factories of this country.

IT is announced that the members of the Leprosy Commission, who are now pursuing their researches in Simla, have made the important discovery that the leprosy bacillus can be isolated and cultivated artificially. A rabbit was inoculated and killed after some days, and distinct leprous nodules were found in the body. It is stated that the bacillus has never before grown outside the human body.

WEIGHING machine and scales of some kind were in use 1600 B.C., for it is said that Abraham at that time "weighed out" 400 shekels of silver, current money with the merchant, to Ephron, the Hittite, as payment for a piece of land, including the cave and all the standing timber "in the field and in the fence." This is said to be the earliest transfer of land of which any record survives, and that the payment was made in the presence of witnesses.

IN cases of chronic bronchitis, with difficult breathing and scanty expectoration, the use of banana juice has been highly praised. The juice is prepared by cutting up the bananas in small pieces, and putting them with plenty of sugar in a closed glass jar. The latter is then placed in cold water, which is gradually made to boil. When the boiling point is reached the process is complete. Of the syrup so made a teaspoonful every hour is the proper dose.

PROFESSOR METZGER, in a lecture at Hendon, remarked as an instance of the prejudice against electricity by some people, on the case of a new central station lately opened up in the neighbourhood of his residence. Two of the more strenuous objectors to the station were a milk dealer and a butcher. The milk dealer protested against the new illuminant on the ground that a leak in the mains had made his milk sour, and the butcher insisted that the current escaped and spoiled all his meat.

THE "Spectre of the Brocken" is a well-known meteorological effect. It was originally observed on the Brocken Mountains in Germany, where the sun occasionally projects the shadow of the spectator on a bank of vapour. Prof. Tyndall has studied the phenomenon at Hindhead, where some heathery uplands broken into valleys favour the observation. Mr. A. W. Clayden, the well-known meteorologist, has now produced the effect by means of a limelight and a London fog. The limelight, which represented the sun, was placed a few feet behind his head, and his shadow was seen upon the fog in front, where it was photographed.

IT appears, from the complete edition of the works of Huygens, now in course of publication at the Hague, that as soon as he had succeeded in applying the pendulum to the regulating of clocks, claims were set up for priority in the invention. The best founded claims were those of Galileo, which were championed by Prince Leopold de Medici. According to the formal statement drawn up by Vivian, Galileo had conceived the idea, but failed to make the application of it. He had a pendulum connected with wheel work, but omitted to provide any weights, springs, or other means of keeping the machinery in motion.

FOR some time past the Paris authorities have been occupied with the consideration of the best means for providing the capital with enormous quantities of frozen meat, in case of siege. They have now decided to construct in the abbattoirs at La Villette a freezing-chamber, which, at a temperture of 14 degrees Fahrenheit, will congeal ten tons of beef per day. In addition to this the authorities have planned a series of storehouses in which the temperature remains permanently at 24 degrees Fahrenheit, and which have a capacity of 2,000 cubic yards each, for keeping the requisite supplies of meat. In time of peace these warehouses will be utilised by civilian butchers.

AT a recent meeting of the Cambridge Philosophical Society, a paper was read by Professor J. J. Thomson, on the electric discharge through rarified gases without electrodes. A vacuum tube was exhibited, in which an electric discharge was induced by passing the discharge of Leyden jars through a thread of mercury contained in a glass tube coiled four times along it. The induced discharge was found to be confined to the part of the vacuum tube which was close to the primary discharge, and it did not show striæ. It was also demonstrated that an ordinary striated discharge is strikingly impeded by the presence of a strong field of magnetic force.

SCIENCE QUERIES AND ANSWERS.

A prize of two shillings and sixpence will be awarded for every interesting question asked by our readers and published in this column, and five shillings will be given for every answer published. In all cases when a similar question or reply is sent in by two or more correspondents, the award will be given to the one whose letter is first opened, provided the subject is properly treated. Questions asked by correspondents and not replied to by our readers, may, if of sufficient interest, be dealt with Editorially.

Rules for Competitors.—(1) Only one question may be sent each week, but any number may be answered. (2) Write on one side of the paper only. (3) Envelopes must be marked "Science Queries and Answers," and must arrive not later than the Monday following date of publication.

The following are Answers to Queries published in No. 17.

25.—Is death by hanging painless ?

Yes ; but only provided that the following rule be observed. Divide 2240 by the weight of the "patient" in pounds, and the quotient gives the length of the drop in feet. This is the shortest permissible drop, consistent with the object of producing painless and instantaneous death. It is at the same time short enough to obviate offensive mangling of the body. It should be remembered that nearly a second may be occupied in falling the number of feet here specified, and that, while free from actual pain, the condemned man must be, during this second, in a condition of mental disquietude equivalent to very acute physical suffering. For this reason, it is considered that what is called the "American method" of hanging should, when possible, be accorded the preference. In this method, the rope is carried over an elevated pulley, and the free end is looped up, and attached to a weight equal to that of the condemned man's body. This weight falls freely, through a distance equal to double the drop that is specified above, and the effect is as quick, as certain, as painless, and, to the spectator, as inoffensive as can be attained by any means hitherto devised.

26.—Is the eye or the ear best suited as a medium of reception for signals to be instantaneously recorded ?

The ear is best, since, as the average of a large number of experiments, it has been found that the transmission of sensation from the ear to the brain, the necessary action of the brain, and the re-transmission of volition from the brain to the hand, occupies only ·09 second. When, on the other hand, the eye is made the primary recipient of sensation, this period is found to extend to ·15 second.

27.—How can the speed of a cannon-ball be best measured, without the aid of electrical appliances ?

By the "ballistic pendulum," that is, a large wooden box, containing, say 5 tons of sand and hung as the "bob" of a strong, and firmly-suspended pendulum. The shot is fired into this box of sand, and from the deflection of the pendulum that results from its momentums the velocity can be very readily estimated.

28.—In the case of a railway train passing over a bridge, is the strain equal for all speeds ?

No ; the downward pressure due to gravity is reduced as the speed of the train increases. It will be reduced a little more when the train is travelling to the east than when it travels to the west. But the most important effect produced on a bridge, by the passage over it of a heavy train, is a condition of vibration of the different parts. Such motions in the structure may either be interfered with or reinforced, according to the relations existing between the "vibratory periods" of the bridge and the velocity of the train. The periods of vibration of almost any mechanical structure can be accurately calculated : and it is, therefore highly desirable that the matter here referred to should be kept in view by engineers.

29.—Is alcohol used by surgeons as an anæsthetic ?

Yes ; by a few surgeons strong whisky is administered for anæsthetic purposes, being inhaled, as fine spray, by the aid of an atomiser. It may also be administered internally for the same purpose ; and, indeed, it is probable that the administration of alcoholic spirits was the method earliest employed by surgeons to produce immunity from the pain of the knife. It is well known that a drunken man will receive cuts, bruises, or even broken bones, without expressing, or experiencing much, if any, pain.

30.—Why do pieces of camphor dart about on the surface of clean, but not of dirty water ?

These motions are due to local diminution of the surface tension of the water—in fact to a similar cause to the movements of "tears of strong wine," referred to by you in No. 14 of SCIENCE SIFTINGS. When soap is dissolved in water, the surface tension is reduced to less than half, and the same differences are no longer to be found between the surface tensions of those portions where camphor has and has not been dissolved. The slightest film of oil, such as may be given to the surface of the water by touching it with a greasy finger, serves also to produce the same effect. About 29 per cent. of the tension at a surface of water is lost when it is coated with a layer of oil. But the tension of the water-oil surface, which is what we are particularly concerned with, is only 25 per cent. of the original tension of the surface of water and air. A film of oil, only 2 micromillimetres in thickness, has been found sufficient to prevent camphor motions. It is interesting to note that such a film is only $\frac{1}{6}$ of the thickness of a soap-bubble film in its black or thinnest possible stage.

QUERIES.

Replies to the following Queries must reach the Office by Monday at latest ; and those selected will be published in the issue after next.

37.—What difference is there between the muscular fibres in men and women that confers upon the former greater strength ?

38.—Are rifled guns necessarily more accurate than smooth-bores ?

39.—State, broadly but concisely, some distinctive feature by which animal life may be defined and recognised.

40.—What is the source and value of the anæsthetic cocaine ?

41.—Is consumption transmissible hereditarily ; and is it infectious ?

42.—State the distinguishing characteristics of mechanical mixture and chemical combination.

SIFTINGS OF THE STUDY.

The Ilford Manual of Photography.

BY PROFESSOR C. H. BOTHAMLEY.

(The Britannia Works Company, Limited, Ilford, London, E.)

This is one of the most useful elementary handbooks on photography that has as yet been published. It is brightly written, and, as might have been expected from Mr. Bothamley's pen, thoroughly reliable. We can confidently recommend it not alone to those about to walk in the pleasant paths of photography, but to such of our readers who wish to acquire theoretical knowledge of the fascinating science. The book, which is handsomely bound in cloth, is published at the remarkably low price of one shilling.

ALL ABOUT THE MOON.

Of all the heavenly bodies, the moon has attracted the most attention among astronomers. This is due to the fact that her comparative nearness to the earth brings her peculiarly within the range of our observation. Group together a few facts about this wonderful heavenly body, for example, and see how interesting they are :

In distance the moon is 240,000 miles away from our earth, around which she gravitates like a satellite.

Her diameter is about 2,153 miles ; she has a solid surface of 14,600,000 miles, and a solid content of about 10,000 cubic miles.

The earth's surface only exceeds the moon's about thirteen and a half times. The moon's surface is fully as large as Africa and Australia together, and nearly as large as North and South America without the islands.

Yet large as the moon is, it would require 70,000,000 of such bodies to equal the volume of the sun. The moon appears to us as large as the sun because she is 400 times nearer to us than the sun.

The time during wnich the moon goes through her entire circuit of the heavens, from any star till she comes to the same star again, is called a sidereal month, and consists of about twenty-seven and a quarter days. The time which intervenes between one new moon and another is called a synodical month, and consists of nearly twenty-nine and a half days.

When the moon is invisible to us it is because her dark hemisphere is turned toward the earth, and this condition of the moon is called new moon ; but when she has travelled a little further on, and has her bright side full toward us, she is our full moon.

A new moon occurs when the sun and moon meet in the same part of the heavens ; but the sun, as well as the moon, is apparently travelling eastward, and nearly at the rate of one degree a day, and consequently during the twenty-seven days while the moon has been going around the earth, the sun has been going forward about the same number of degrees in the same direction. Hence, when the moon comes around to the part of the heavens where she passed the sun last, she does not find him there, and must go on more than two days before she comes up with him again.

The moon has two motions, one of revolution around the earth, another of rotation on itself. These two movements, by a curious coincidence, are made in the same interval of time. We know that there is a new moon when our satellite is invisible both during the day and night. She then occupies a place very near the sun in the heavens, presenting to us her dark hemisphere ; for this reason, and because she is merged in the splendour of the solar rays, she is then invisible to us.

About four days elapse between the disappearance of the moon in the morning in the east, and her reappearance in the evening in the west, a little after the setting of the sun.

Between the first quarter and the full moon seven days elapse, during which the form of the illuminated part approaches nearer and nearer to that of a complete circle; the moon rises and sets later and later, always turning towards the west the circular portion of her disc. About fifteen days after the new moon, the whole of her illuminated portion is presented to us, and the hour of her rising is nearly that of the setting of the sun, which in turn rises when the moon sets. It is midnight when she attains the highest part of her course ; then the sun itself passes the lower meridian under the horizon ; that is to say, relatively to the earth, the moon is precisely opposite the sun.

The light which the moon gives, which we call "moonlight," is given by the sun, and is reflected back from her surface, just as it is from Venus and the rest of the planets. The moon is a solid globe like the planets, and she does not shine by any light of her own.

The power of the light of the moon is inferior to that of the sun. Dr. Wollaston, by certain photometric methods, compared the light of the sun with that of the full moon, and found that to obtain moonlight as intense in its lustre as sunlight, it would be necessary that 801,072 full moons should be stationed in the firmament together.

When viewed through a good telescope, the surface of the moon presents a wonderful aspect—extensive valleys, shelving rocks, and long ridges of elevated mountains projecting their shadows on the plains below. The mountain scenery equals in grandeur the rugged Alpine heights and the Appenines, after which some of her mountains have been named.

SUSCEPTIBILITY TO DISEASE.

Of several persons who have been equally exposed to chilly weather one takes a fatal cold, while the others are wholly unaffected. When scarlet fever or diphtheria enters a family, it is a rare thing for all the members to be attacked. The great majority have escaped the influenza. And the same is true of epidemics of every kind and degree.

This difference is mainly due to difference in personal susceptibility, inherited or acquired. Disease invades the body at points where its life-forces are weakened. Such a lowering of the vital resistance may date back for generations. This is one reason for the astounding mortality of infants, so immensely beyond that in the young of some of the lower animals. Many persons who start with small power of resistance carry it through life. Their only hope is constant care and freedom from exposure.

But of those who reach adult age, the greater part may be supposed to have inherited an average measure of physical soundness. Whence their susceptibility to disease ? It comes from physical transgression, either positive or negative.

Sleep, for instance, is a fundamental condition of high health. Nothing can make up for a deficiency of it. Lack of food does not begin to equal lack of sleep in its power to depress vitality, and so to render the system liable to any prevailing disease. Still, insufficiency of food is a great depressant, and may exist where it is least suspected ; for the food must be such as to supply the daily waste of all the tissues—brain, nerve, bone, muscle, and fat—besides furnishing heat-forming fuel. Many a person who sits at a luxurious table is not half fed.

But over-eating is as bad as under-eating, and often acts more promptly. All the organs, especially those that eliminate the waste, are overworked and weakened. Poisonous waste is retained in the circulating fluid. Any over-indulgence wastes the nerve elements faster than they can be supplied, and nerve force is behind the normal working of every organ.

Worry and care have a like effect, not only rapidly using up nerve force, but also weakening the organs that elaborate it. Fear, also, is a great vital depressant, and by itself often induces a fatal susceptibility to epidemic diseases. Temporary, and yet fatal, susceptibility may be caused by fatigue. Eight white rats, having been subjected to exhausting exercise for several days, were inoculated with an attenuated poison. Four others in a normal condition were similarly inoculated. All four of the second series survived, while seven of the first series died.

IS MAN DEGENERATING?

One-half of mankind lives as the animals live, "the hog life," a recent writer has bluntly expressed it. Such people live only for present animal gratifications; but being unfortunately endowed with brains, they are not satisfied. A brilliant lawyer was recently heard to say, "I wish I were constituted as dull as John H., for he seems really to be satisfied with his gluttonous grossness; I am not." To get low enough down to find content seems to be the desideratum of these people. Then another large moiety is living for money getting. Every one of them avows discontent with what he achieves. Your discontented masses are not composed strictly of the poorer, undifferentiated sort, but also of the richer, well-off people. There really is but one life that is satisfying, and that is the life beautiful.

Human folk made no mistake when, after centuries of civilisation, they settled down on the word "gentle" as covering the finest type of being. But is there a word in any language that better illustrates the power we have to empty out the original meaning of a phrase, and fill it with falsehood, than the word gentleman? The gentleman and gentlewoman of to-day are least of all gentle, but are harsh, cold, superficial, and made-up folk, with rare exceptions. The real gentle one is hard to find anywhere. He it is who opens the doors of the life beautiful and lives in the sunshine of the soul. We daily, and by necessity of business, pass hours with men who could not by any stretch of honest definition be classed as refined or gentle, or placed anywhere above the physical, except in the matter of acquisitiveness. We have strained our imagination to clothe them with any ideas of the beautiful. They are not so. Every thought is given to the sensuous or sensual. They are not the day labourers, wheeling brick or sand, and sweeping the streets, but well-dressed men in rich warehouses, shops, and offices. They are merchants, lawyers, and even ministers. We hear much that would not be tolerated in a family circle, and the question is whether any man really can live a double life—whether he can be pure, fine, noble, true, and sweet-souled in his family, and something else in other relations of life. It is not needful that four-fifths of a business man's career shall be empty of fine purpose and fine thought, or what is more common, devoted to a coarse method of speech and habit. Do these men ever taste the pleasures of a truly noble life? They sneer at sentiment in the street and in the shop, but what kind of a sentiment have they anywhere?

There is no evil worse anywhere than cowardice; no grace more beneficent and useful than courage. This was recognised to be so in the physical force age; it is reckoned justly to be so in the moral era, and under the rule of enlightened ideas. The difficulty everywhere is cowardice. People dare not be true, simple-hearted, pure, honest, frank. Then still worse comes about this nasty realism which is only a frank materialism; an honest smut and smudge; a brave nakedness; an unrevised and exposed physical condition. What we need is a brave will to be beautiful, and a courage to be kindly; and so to weave about the hardest life thoughts and emotions of tenderness.

We have not yet got very far on the road of evolution. Some one has told us now we shall change physically, and others have guessed at our intellectual future. Our psychical future will undoubtedly be still more unlike the present, and very far advanced over the present. It is not unlikely that the men of the thirtieth century will speak of us more contemptuously than we speak of the Dark Ages. Certain it is that we have only discovered the finer soul qualities, and do not dare to live them out. By and bye the whole human being will become sacred; and we shall not be so proud of the brain and so ashamed of the body. We shall know the laws of purity, and honour, and temperance, and shall be able to live up to them. Now our hardest struggle is to find out how to live decently; the next is to get pluck to live as we discover is beautiful.

Imitation is one of the strongest of human traits, if not the strongest. We are all trying to do as other folk do. The result is fools have a good chance of having the most influence. If our neighbour stutters, we get to stammering; and if he swears we at least feel like doing the same. If we do not, it is because some one else does not. The higher classes imitate more than the lower sort do, although the habit is bad enough all up and down the scale. It follows that we are always in great need of heroes who can make themselves community or national models. When we get the right sort of models, we grow into doing beautiful things.

We have sometimes wondered if the truly beautiful will not be unconsciously so. It is our struggling after anything that makes us conscious of its lack, or of its attainment, but by-and-bye, when every muscle and every purpose are rounded to completeness, the fine body and the fine soul will work on like a perfect engine, so smoothly as to hardly know their own completeness. Is this desirable? Most certainly the least agreeable creature in the world is a person conscious of the possession of special charms. She or he, whichever it may be, is very sure to misuse, and finally lose whatever beauty is possessed. True beauty, rightly used, is immortal; it can not be lost. The most beautiful person on earth is utterly devoid of vanity; he is simply too perfect to be keenly self-conscious of his possession.

The future ideal must be a person well put up in all respects—physically, intellectually, and morally. These must go together. A bad body is never quite the servant of a fine will. Heredity is almost a new word. It shows we have but just begun to think that we can endow our babes with something better or else than cash and lands. It is a glorious thing to be able to make sure that our children shall be well endowed. Every thought of a father, every deed of a mother, every wish and purpose of either, run down the ages to make or mar the future generations. It is not to himself alone one may be beautiful, or be ugly.

Plato, and after him Aristotle, defined beauty as essentially consisting in harmony. That is, a person may be beautiful only as the character harmonises in all its parts. It is possible to be witty and yet ugly; to be very learned and yet very ugly; to be very wealthy and yet ugly. That is, the chief danger we have is the growing disproportioned, or one ways. Is then the true end of education learning, or wit? or is it beauty? We think it is the latter; and that our schools make a very general mistake in trying simply to develop intellect. The emotional life in man is proportionately feeble; the rational life in woman is relatively weak. Men are ashamed to be gentle, kindly, affectionate. The secret of Christianity—the original article—is the childlike spirit. The founder held a little child to be an ideal. That is, a small child, not yet spoiled by training, is more harmonious than a mature adult. Set this before us as the proper end of culture, the completest body and the completest unfolding of all the powers of the human being. We shall learn after awhile—are indeed already learning—that the grandest thing is not a red-hot brain, capable of brilliant

coruscations, and of amassing a vast amount of learning. Our scholars are not beautiful in the Platonic sense. The life beautiful involves a healthy body, holding a healthy mind.

That other grand division of Platonic philosophy into the science of the True, the Beautiful, and the Good, leads to the problem which of the three is, after all, the end of philosophy. Is it the truth that we are to live for, and be willing to die for; or is it to become good that we should aim and desire? In the light of that already written, we are warranted in saying that the end of all things is beauty (harmony). Truth in itself is of no balm, except to create something; that something is the beautiful. Goodness is justice to others; it is temperance in ourselves. Why are these good? Only because they end in beauty.

Why is our age producing so many more beautiful old women than old men? Money, love, and sensual weakness create intolerable flabbiness and disagreeableness. The amount of human ugliness is enormous. We have become so accustomed to see it that we do not concern ourselves about it. But it is horrible. Every feature has been, in one way and another, distorted and made abhorrent. What noses! swollen till no beast possesses a more detestable feature. What mouths! expressive of vulgarity and selfishness and brutality. What eyes! hollowed by lust, fired by passion, burned out. For comfort we go back to the conviction, already expressed, that we have only touched the threshold of the evolution of humanity. So far four-fifths degenerate. So far we have not only climbed above the apes, but descended lower than apes. Not a creature now exists whose ancestor was not strikingly unlike itself. The ancestor of the horse was no bigger than a mastiff. What will your future horse be? This only we know, that evolution becomes fixed, in each sort of creature, into a few lines. Horses evolve on the lines of speed, of strength, of intelligence; birds on the line of flight, of beauty, of plumage, of size and fertility. Man will have to develop on his own lines. Then, is he degenerating? Can these lines all converge in the production of a superbly harmonious, beautiful being? What is an angel but an ideal of what man ought to be? Take off the wings, and you have the model human being.

A FEW DEFINITIONS.

The poet Tennyson can take a worthless sheet of paper and, by writing a poem on it, make it worth thirteen thousand pounds. That's genius.

Rothschild can write a few words on a sheet of paper and make it worth a million pounds. That's capital.

Great Britain can take about 123 grains of gold and stamp the Queen's head upon it and make it worth a sovereign. That's money.

The mechanic can take the material worth a pound and make it into a watch worth twenty pounds. That's skill.

The merchant can take an article worth ninepence and sell it for five shillings. That's business.

The navvy works ten hours a day and shovels three or four tons of earth for four shillings. That's labour.

THE flora of Europe embraces about 10,000 species. India has about 15,000. The British possessions in North America, though with an area nearly as large as Europe, have only about 5,000. One of the richest floras is that of Cape of Good Hope and Natal, which figures up about 10,000 species. Australia also is rich in species, about 10,000 being now known.

WHAT HEAT AND ELECTRICITY DO FOR THE BODY.

The cause of sun heat is generally considered due to the passage of the light rays of the sun through our atmosphere. Light, heat, and electricity bear a striking relation to each other, says Dr. J. D. Bonnar, in a paper read before the Buffalo Electrical Society, in fact, they are convertible terms—either may be converted into the other. Heat and motion are also interconvertible. This latter statement is true of matter, whether in masses or in molecules. Chemistry also shows us that the combination of substances having chemical affinities for each other produces heat.

To go back to our starting point, viz., that the sun is the origin of all heat, and also of all light. We are told by astronomers that the sun is a great molten mass. From our own experiments, we learn that all bodies which combine chemically with each other have certain opposite electrical conditions, and they unite with each other, producing an electrical current, which may be conveyed along wires to distances remote from the place of origin. We find that the electrical conditions are in definite and constant proportion to the attraction or force with which bodies seek to combine with one another. Hence, may we not justly conclude that in the sun the same conditions control the chemical combinations continually going on in its structure? If we are justified in this inference, then we are also justified in the assumption that electrical attractions between the bodies entering into combination are set up and currents sent in all directions throughout the solar system, and only producing light and heat when they reach the atmosphere which envelopes the earth. The currents of electricity are met by the resistance of the atmosphere, which is a very poor conductor of electricity. Hence, we have both light and heat, which we know are produced by electrical currents, when transmitted through bad conducting media, such as platinum wire or bamboo cane, and just in proportion to the resistance offered in the track of the electrical energy. The diffused light of day can then reasonably be regarded as the fruits of the infinitely great number of electrical rays passing from the sun through the resisting atmospheric media. When the air is full of moisture, the day is darker, due, no doubt, to the well-known fact that moist air is a much better conductor of electricity than dry air, presenting, as it does, much less resistance to the electrical effort to reach the earth.

The sun "might be looked upon as a huge battery," in which the elements are constantly combining and decomposing, and thereby originating or generating electrical rays.

Heat and electricity are so intimately related as to be, in fact, an offspring the one of the other, and it often tests the discernment of the most astute reasoner or observer to tell which is the parent power. Coincident with an increase in the electrical potential in the human body, or part of the body, there is also an increase in the heat of the same, and when our bodies are in a highly electrical condition, or in high potential, we are warmer than when the potential is lower; so, therefore, we find people more vivacious and merry in dry and bright weather than in damp conditions of the atmosphere. By means of the moisture, the electrical potential is lessened. Again, we find that in all inflammatory conditions there is an increase in the positive electricity, so we treat inflammation and all diseases which show increased activity in a part, by applying the positive pole over the affected part, or, conversely, in affections where there is a deficiency in the normal activity, we reverse the electrodes, by applying the negative over the seat of the disease, while the positive is applied at some point remote

from it. Thus, we strive to bring about a physiological, natural, and normal state of equilibrium.

A simple contrivance shows that the electric current flows from the metal of higher to the one of lower potential, as heat from a higher to a lower temperature, and the same is true in animate bodies as in the inanimate metals. How often have we all noticed that there is a peculiar sensation, or, in fact, a slight shock, experienced when we shake hands with some people, the cause being simply, that the electricity of higher potential in one is flowing over to the other of lower potential. Hence, we infer that the uses of heat may be similar to those of electricity in the cure of disease ; in fact, we are using this heat agent vastly more often than electricity, because its character and effects are vastly better known.

ANIMALS HARD TO KILL.

By noting the behaviour of a wounded animal a very good idea of the seat and nature of the injury may be generally obtained. A missile passing through a portion of the brain substance almost invariably causes instant death. There are, however, many examples of recovery after such an injury scattered through medical literature. Even in these cases the patient is necessarily rendered unconscious for many hours, so that the hunter who inflicts such an injury upon an animal attains his end. In hunting dangerous game at close quarters, then, we are told by Dr. J. W. Hall, the brain should ordinarily be the objective point, unless the bullet be very heavy in proportion to the size of the animal. It is generally accessible, and, if struck, invariably renders the game harmless. A grizzly bear with a rifle bullet through the heart may yet live long enough to kill his destroyer, if at close quarters. Several such instances have occurred. With his back broken, the bear may yet strike viciously with his paw, but a shot in the brain ends the battle. When, then, a mammal drops instantly on being struck, and all visible movement ceases, it is fair to assume that the brain or the cervical portion of the spinal cord has been injured. Among birds and reptiles, however, this rule does not hold. In these orders, the spinal cord assumes much more extensive functions, as compared with the brain, than in the mammalia. Doubtless everyone has seen bodily movements continue long after the destruction or total separation of the head of the snake, for instance ; while the movements of the chicken under similar circumstances are familiar to all. Again, in certain game, the immediate effect of injuries to the brain or cord may not be to produce complete paralysis. Birds on the wing, struck in the head by a small shot, often rise almost perpendicularly into the air for an instant before falling dead. Small animals may pass through a series of convulsive movements after a wound of the cranium. In the rabbit, under these circumstances, the powerful contractions of the muscles of the hind legs often throw the body several feet into the air, but the animal is unconscious, of course. In the larger mammals, and, it is stated by those familiar with war, in man, a single jump often results from a bullet wound in the head. This is evidently the analogue of the convulsions seen in the lower animals, the muscular contractions originating from the irritation of the motor centres of the brain by the ball.

THE great Lick telescope reveals about 100,000,000 of stars, and every one of them is a sun, theoretically and by analogy giving light and heat to his planets; this telescope reveals stars so small that it would require 30,000 of them to be visible to the naked eye.

MUST "UNIVERSAL ATTRACTION" GO?

On several occasions since 1879, writes M. C. V. Zenger a French scientist, I have shown that the astronomical and meteorological phenomena that have been attributed to the action of universal gravitation or of gravity are, on the contrary, easily explained by the electrodynamic theory of the sun—a theory that I proposed in 1878.

Much opposition and many objections were presented to me without any one having endeavoured to refute this theory by the only way admissible, that is to say, by properly performed experiments. I proposed to prove, by this means, the only sure and conclusive one, that the phenomena of attraction and repulsion observed in the motions of the celestial bodies, in the whirling motions of the atmosphere, and in the seismic motions of our globe can be reproduced by the electrodynamic action of powerful electromagnets, or by the energetic discharges of any electric machine whatever. In 1885 I described the vortical phenomena produced in a bell glass filled with white smoke derived from the combustion of magnesium when a partial vacuum has been produced by an air pump. From this experiment I deduced the conclusion that the great vortical disturbances of the atmosphere, cyclones, typhoons, and tornadoes, are very probably of electric origin, and that atmospheric electricity is the cause and not the effect of these intense vortical motions.

The periodicity of about thirteen days observed in cyclonic storms, cyclones, and typhoons has led me to admit the solar origin of the high electric tensions observed in the upper regions of the terrestrial atmosphere. Having demonstrated the same periodicity for magnetic storms, whose solar origin is at present generally admitted, and for the northern lights which very often accompany them, I have been led to suspect like periodicity in seismic movements and in volcanic eruptions, which seem to be nothing less than the effect of igneous vortices formed under the electrodynamic influence of the sun upon the fluid core of the earth ; and, in acting, these storms of the fluid ocean produce in their turn a counter effect upon the solidified and rugose crust of the globe.

This periodicity once proved, all the great movements of the atmosphere and of the interior of the globe are found to be governed by an identical recurrence, to wit, the duration of a half revolution of the sun. These phenomena manifest their electric origin, and it is seen that they are produced by electromagnetic induction and by the direct discharge of electricity between the sun and the earth through interplanetary space.

During the Universal Exposition of 1889, I demonstrated, with my apparatus with three electromagnets acting upon a hollow copper sphere, suspended by a silk thread, and rotated by the torsion of the latter, that it is possible, under the action of one, two, or three poles, to reproduce the orbicular motions of the planets around the sun, circular, elliptical, or more or less eccentric, and that it is even possible to reproduce the phenomena of planetary perturbations. It is with this apparatus that we can solve the problems of the action of three bodies, and figure the orbits thus described.

In order to fill the gaps of my electrodynamic theory of the motions in the solar system, it still remained for me to imitate the revolution of the planets around their axis through electrodynamic action. Now I succeeded in this by the revolving of a glass globe under the influence of the discharges of a Wimshurst electric machine. In the direction of its vertical diameter, I deformed a hollow,

silvered glass sphere, such as is found in commerce, and placed a steel axis in the conical cavity thus obtained.

The axis is fixed upon a wooden support and insulated from the table by a hollow glass cylinder. Upon placing the hollow sphere between the balls of the exciter of a Wimshurst machine in such a way that the said balls shall be at a distance of several centimetres from the surface of the hollow sphere (this being indispensable in order to prevent the formation of sparks), we obtain a rotation of the sphere around its vertical axis.

In this way the right line that joins the centres of the balls of the exciter does not pass through the centre of the glass sphere. When we begin to turn the winch of the electric machine, the sphere begins to revolve, and its motion becomes thoroughly uniform when the winch is turned uniformly. The faster it is turned, the quicker become the revolutions. This rotary motion may thus be made to obey the hand of the experimenter.

This revolution of a hollow sphere under the influence of the two poles of an electric machine, surprisingly confirms the views as to the origin of celestial motions that I have mentioned. It is very probable that the sun behaves like a huge dynamo-electric machine acting upon the bodies situated in its vicinity, as are the different planets of its system. The energy of the sun manifests itself, then, by determining *all the motions* in interplanetary space, on the surface and in the interior of the planets. *The revolutions of these latter, like those of comets and meteorites, are due solely to the motions resulting from the action of the dynamic poles of this enormous source of energy.* But these reproductions of terrestrial cyclonic movements and of orbicular and rotary planetary motions through electricity would not seem to me yet conclusive enough to permit of replacing by electrodynamic laws those of universal gravitation, were it not possible to reproduce likewise, through electrodynamic action, the phenomena of activity observed on the surface of the sun. This I have very recently been enabled to accomplish through electric discharges in a space filled with dust, and upon smoked plates of glass.

The means that I have employed appears to be more conclusive still than the action of electric discharges upon photographic plates employed by Mr. Trouvelot. The absolute mobility of the particles of lampblack has permitted me to follow the lines of electric force during the discharges, and I have thus been enabled to show that the discharge produces two vortical motions, *dextrorsum* and *sinistrorsum*, which in uniting destroy every manifestation of the energy derived from the discharge. When we smoke plates of glass covered in the centre with a circular piece of tinfoil, and the positive ball of the exciter is discharged against the disc, the lines of electric force delineate, in white upon a black ground, all the aspects of the solar protuberances, in the form of tongues of flames, and of recurved columns, and often in the form of a spiral.

This image thus obtained is, so to speak, the representation of a total eclipse of the sun, the tinfoil disc representing the moon covering the sun, surrounded at the edges by protuberances projected into space.

If we replace the tinfoil disc by a thick disc of copper, the lines of force derived from the edge most distant from the surface of lampblack, become more or less inclined toward the said surface, and the result is a diffused whitish zone, perfectly recalling, by its form and texture, the solar corona, and even with protuberances which are projected upon it.

Upon smoking a hollow glass sphere and directing the positive discharges upon the blackened surface, we obtain a representation of the solar spots in white upon a black ground. We reproduce the vortical motions and we recognise the grains of rice, the tongues, and the spirals, as we observe them in the penumbra, etc., and the bridges that we see in the shadow of the large cyclonic spots of the sun.

If instead of a smoked plate of glass we take a mirror whose layer of silver is protected by varnish, the discharges not only delineate spots, but through lateral discharges we obtain groups of spots, sometimes large, sometimes small, succeeding each other as they appear in reality upon the surface of the sun in times of great explosive activity. It is, so to speak, the *ensemble* of the solar phenomena produced artificially upon thin unfixed layers of lampblack or silver by the powerful electric discharges of a Wimshurst electric machine or by the Rhumkorff coil. In a note upon the periodicity of comets, we can explain the formation of comets by enormous explosions driving the substance of the protuberances to hundreds of thousands of kilometres from the surface of the sun. The shocks must propagate (*sic*) themselves to the edge of the corona and drive the matter, which is perhaps meteoric, in advance of it from the corona. Let us suppose, moreover, that pretty big meteorites are moving around the sun near the edge of the corona. Their attraction may be greater than that of the sun, and there may be thus produced an agglomeration of coronal matter around the meteoric nucleus, and the head of the comet may be formed; but the attraction of the motion of the mass thus agglomerated may carry along meteoric dust and minute particles of the coronal substance, or what produces the coma and the tail. The resistance of the perpetual shocks of the nucleus against the meteorological matter which abounds in the vicinity of the sun causes the length of the tail to increase rapidly and produces the distorted appearance of cometary tails.

The success of my electric experiments has given me the idea of reproducing the same phenomena by electric discharges against a rugose surface, for example, against the smoked surface of Swedish filtering paper. If the discharges are at right angles, we obtain in white the image of the nucleus of the comet surrounded by the hair in varying shades of grey. But if the discharges are made obliquely to the smoked surface of the paper, we obtain a distorted tail. We observe, moreover, a dark or black line often separating the head from the tail and traversing the latter, as in the large comets, at great distances from the brilliant nucleus.

This is a new proof that constitutes to the better making understood of the enigmatic forms of cometary tails, of their rapid growth in the vicinity of the sun, of the repulsions that they undergo, of the rapid changes in luminosity that they experience, of the flashes that were perceived in the tail of the comet of 1881, and, finally, of a multitude of other phenomena that are wholly inexplicable by universal attraction solely,

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A DIAMOND, however small, will reflect an object or a landscape, and show to the eye a brilliant and perfect picture. To illustrate this the operator must place himself with his back to the object to be reflected, and raise the hand containing a diamond ring so that the stone is close to the eye, and opposite the object. Close the eye not in use, and move the diamond closer to or further away from the eye, to bring the picture to a sharp focus. By this means it is possible for a person to sit in a room with his back to the company and see all that is going on.

ELECTRICITY UP TO DATE.

(Continued from p. 231.)

We have paid a second visit to the Crystal Palace Electrical Exhibition, and have found, as might be expected, more than enough food for careful reflection ; and sufficient material to occupy treble the space allotted to this article. Among the firms whose exhibits embrace the whole range of electrical industry, Messrs. Woodhouse and Rawson, at their magnificent stand in the north nave, figure conspicuously. Wires and cables for holding the electric current—by no means the least important item in an electric lighting plant—are supplied by this firm. It is necessary, to prevent dangerous leakage of electricity, that such wires should be most carefully "insulated" ; that is, covered with a material such as gutta-percha, cotton, or silk, which refuses to conduct even the smallest electric current. Any considerable diversion of the flow of electricity from the path designed for it will result in loss of power. Serious heating and sparking may also occur in such circumstances, and may result, if undetected, in a conflagration ; as has been too often proved, at the expense of those whose electrical installations have been designed by incompetent persons. An electric lighting main that is brittle, or of which the insulation is defective, may, in certain positions, be as dangerous as a leaky gas pipe. Hence, stranded wires are preferred to any other form, and they are now frequently inclosed by insulating main pipes—the best are Rylands' patent glass-lined tubes, shown at stand No. 36. No less important than the wiring itself is the method by which electricity is switched from one section to another of the system of wires. The little buttons by means of which glow lamps are lighted up or extinguished, and the massive appliances designed for controlling the path of a heavy current, are all included in the denomination of "switches." Switches are one of Messrs. Woodhouse and Rawson's most celebrated specialities. They are shown large and small, and in every variety. Some are provided with safety "fuses," of a size and composition such as to melt, at a low temperature, when more than a certain quantity of current passes through them. Another device, which accomplishes the same object in an admirable manner, is Woodhouse and Rawson's electro-magnetic cut out. Several other pieces of apparatus are also exhibited by which the direction or strength of a current can be ascertained, or by which the dangers of an accidental short circuit are minimised. We understand that Mr. Boardman's "sun lamp," which has recently been greatly improved, is being also manufactured by the same firm. It will be remembered that a lamp on the same principle—that is a kind of electric lime light, excited considerable attention at the great Electrical Exhibition in Paris. Large and small electromotors are also manufactured by Woodhouse and Rawson, and find a place in the exhibit under notice.

Electromotors are a good illustration of the principle of reversibility, of which we find so many examples in physical science. Every one knows that an expenditure of mechanical force is necessary to give rise, for example, to a wave of sound. So also, waves of sound can be employed to set delicate machinery in motion. Thus light and heat, the production of which also absorbs mechanical power, are capable reciprocally of giving a part of that power back. We are not surprised, therefore, to learn that dynamo machines, in which the rotation of certain parts give rise to an electric current, are also applicable conversely to the transformation of electricity into motive force. Even the little influence machines which are, or which ought to be, in the possession of every science student, have been made to work as electromotors. All commercial motors are, however, of the electro-magnetic type. Of this, the very simplest example is a common electric bell. A bar of soft iron is made into a magnet by the passage of a current of electricity through a surrounding coil of wire. Magnetisation of the iron causes attraction of a little armature, attached to the lever of the bell hammer. An impulse is given to the hammer, which, by its forward motion as it is thrown against the bell, serves to open or break the electric circuit. With the stoppage of the current magnetisation in the soft iron instantly dies out. And the attraction between the "electro-magnet" and its armature is at an end until, by the agency of a spring, upon which, as a rule, the bell hammer is mounted, the original condition of things has been restored. These phases succeed one another with great rapidity in the action of a common electric bell. And we may add that in this instrument one has not only a simple, but also a remarkably economical transformer of electrical into mechanical energy. Electric bells, lampholders, and other domestic electrical appliances, are all manufactured by Messrs. Woodhouse and Rawson, and many of these are to be found among the exhibits on the present occasion.

It is appropriate to mention here, that both raw and manufactured materials—ebonite, indiarubber, vulcanised rubber, and other compounds for insulating purposes—are exhibited by the Britannia Rubber and Kamptulicon Co. Another interesting exhibit, and one equally attractive to electrical dealers, is that of Messrs. Wiggins and Co. in the South Gallery. Messrs. Wiggins are large importers of mica, and show every variety and form of this useful insulating material. Notwithstanding the intangible and in many ways mysterious character of electricity, it is a force that is susceptible of more accurate measurement than either mechanical power, heat, or light. A pocket compass is a crude electric measuring instrument, as can be shown by placing it over a horizontal wire, conveying an electric current, and lying in a north and south direction. The needle will be diverted from its normal position and will set itself at an angle with the subjacent wire which is greater as the current is increased. Many of the most perfect electric measuring instruments of various types are exhibited at the Crystal Palace by Messrs. Nalder Bros. and Co.

Most electric current indicators may be regarded as virtually electromotors, in which the rotation force of the motor — in this case a magnetised needle — is balanced for the purpose of measurement, against the torsion of a thread or the magnetic force of the earth. In the telephone, however, we have even a prettier example of the electromotor on a very small scale. Sound waves, as we have already remarked, can be transformed into mechanical motions in a suitable piece of mechanism. The telephone receiver is such a mechanism. And the gentle areal pulsations constituting spoken sounds are enough to impress upon the diaphragm or armature of a telephone reciprocating motions of corresponding amplitudes and of exactly the same frequency. The telephone has a magnetised steel bar, and a coil of insulated wire; it is, in fact, a miniature dynamo machine. The motions of its armature induce electric currents which traverse the line wire and, by virtue of the reversibility we have already spoken of, reproduce in a second telephone the trembling motions of the armatures in the first. Such telephones, and other varieties of the instrument, which space will not permit us to mention, are made and supplied by the Scientific Alliance. This firm is also one of the first manufacturers of experimental electrical apparatus for educational purposes. Their exhibit is well worth the attention of electrical students.

A NEW SOURCE OF GOLD.

It may be remembered by our readers that in No. 4 of SCIENCE SIFTINGS we referred to the quantity of precious metals contained in the waters of the ocean, and to the impossibility, by any process hitherto devised, of converting these vast and hidden riches to the use of man. Our paragraph met the eye of an inventor, and the idea of recovering gold from sea water has been developed in a strikingly important manner. Many of our readers may be aware that natural causes, not only have been during ages past, but still are carrying both gold and silver suspended or dissolved in streams and rivers to the sea. How much of these commercially, and—in proportion as their market price is lowered—technically, useful metals have been absorbed in this way may seem almost past belief. It is a fact, however, that chemical analysis has shown the presence of one-eighth of a grain of silver in every ton of common sea water. The presence of gold has also been demonstrated, and its amount is placed by good authorities at one grain to the ton. It may be less—say three-quarters of a grain of gold to every ton of water—and, for the purpose of this article, it will be more than sufficient if we assume that the proportion is but half a grain. Neglecting the silver, we find, upon this moderate computation, that more than a million times the quantity of gold coin now in circulation in the whole world is represented by metal held in chemical solution in the sea. And, by reason of the constant and rapid circulation to which the contents of the ocean are subjected by the Gulf Stream and other great currents traversing the whole aqueous surface of the globe, it would be possible—we do not say necessarily economical—but possible, by any process of extracting this gold, to recover it at one fixed spot, and at an extremely rapid rate, to the extent of many million tons, without reducing the proportion present on the average, or even in any limited portion of the sea, by an appreciable extent. It is a method by which, probably, the extraction of this gold could be effected that we now announce. *Electrolysis* affords the means by which gold and silver, together with platinum and some other rare metals, if these also be present, can be derived most economically from their solution in the sea. Electric currents will yield deposits of these metals from their compounds in sea water, when of such feeble E.M.F. as to exert but little decomposing action on the other far more common saline constituents. And, so far as concerns what *a priori* can be predicated of this new suggestion, we may add that, being so far developed and worked out as to present a most important aspect, it now offers no firm handle to which any technical objection against it, as a process commercially possible, can be fixed. The low electro motive force (below one volt) employed is much in favour of the process ; and we are enabled to state that, by means of what seem to be careful and reliable estimates, it has been shown that the cost of gold thus "electroplated" from the sea may be considerably under present market prices of the metal. It is needless to add that ample patent protection has already been applied for.

WHEN the Mosque of St. Sophia, in Constantinople, was built, more than 1000 years ago, the stones and bricks were laid in mortar mixed with a solution of musk, and the building has been fragrant with the odour ever since.

TO INVENTORS.—Anyone having a good Invention can, on applying to the Editor, "Science Siftings," obtain the advice and assistance of a well-known Patent Expert, free of charge.

TRIUMPH OVER TRICHINOSIS.

Considerable attention has been devoted of late years by the Government of the United States to the cause and cure of trichinosis, and the conclusion, recently arrived at, that the pest is derived from rats, has given new impetus to the pursuit of this line of investigation. Every one has his little foible, and a pig appears to be fond of a rat. Dr. Leuckhart, the great Leipsic professor, who made the discovery in question, collected those interesting rodents from all over Germany, particularly from distilleries, slaughter houses, and sewers. By dissection it was found that 40 per cent. of them were infected by trichinæ.

Rats are cannibals. They eat their own offspring and each other, so that in this way the infection is spread among them. Whether they ever die of trichinosis is not known, although it makes them lame sometimes ; but an ascertained fact is that pigs devour them whenever they get a chance, and so contract the complaint. Human beings in their turn eat the pigs, and thus acquire the trichinæ, with frequently fatal results. The disease is reckoned the most deadly known, inasmuch as it kills in 60 per cent. of all cases. Among the many animals attacked by it are cats, dogs, horses, bears, and rabbits, though how they get the parasites is uncertain.

About the year 1835 a great discovery was made. A London medical student found a number of little cysts in the muscles of a human being, each of which contained a minute worm. The parasite was described by Professor Richard Owen under the name of *trichina spiralis*, and he expressed the opinion that it was harmless. But not long afterwards an epidemic of what is now known as trichinosis occurred, and it was found that all of the victims had eaten pork which proved to contain cysts with worms in them. At last the secret of this dreadful complaint, which had so long been regarded as an insoluble mystery, was out, and the result was of vast benefit, because science was set to work at hunting at other diseases to see whether they were caused by parasites. Hence originally came the first knowledge of the ill-doings of certain bacteria.

After several epidemics of trichinosis had occurred, several nations of Europe, and particularly Germany, came to the conclusion that all meats should be inspected. In Germany to-day no meat of any kind is sold which has not been subjected to official examination. A few years ago there was a very severe epidemic in that country which was traced to American pork. No mistake could exist because the parasites were found in the pork, from Chicago, which the victims had eaten. Therefore, it was decided that the Yankee hog should be excluded. Since the law was enforced compelling the inspection of every pig sent to market from America, the objection has been withdrawn.

Owing to the commercial importance of the American hog, the United States Government has taken especial interest in the *trichina spiralis*. There is much that is surprising to be told respecting it. About three days after infected pork has been eaten and digested, the little worms become free in the intestines, and proceed to breed, being males and females. A single female gives birth to from 150 to 15,000 young. The latter, as soon as they are hatched out, crawl through the walls of the intestines and get inside the fibres which compose the muscles, where they feed upon the contractile substance. They may find lodgment in any muscle in the body, but they chiefly attack those of breathing and swallowing. Thus the patient dies of suffocation. If only a hundred or so of these creatures have been taken into the system the person is likely to

recover, but a single bite of thoroughly infected meat will contain a sufficient number of the parasites to prove fatal. Medical treatment is of hardly any avail, the physician's efforts being limited to sustaining vitality with stimulants until the crisis shall have passed. This time arrives when the trichinæ have ceased feeding and are inclosing themselves in cysts with a view to permanent residence. After that they can do no more harm, unless the individual should be himself eaten by a cannibal, in which case the latter would be apt to contract the complaint.

SOMETHING ABOUT MALARIA.

Is it possible that some day a method of inoculation for the prevention of malaria may be devised? Science has got hold of the germ recently, and identified it beyond question. It is not a bacillus or any kind of bacterium, as has been imagined, but an animal parasite. The name given to it is plasmodium malariæ. It belongs to the lowest grade of animal life, being a "protozoon."

This little parasite, which is of microsopic dimensions, appears to make its home ordinarily in the soil. It is plentiful in swamps, but wherever virgin ground is turned up for the first time, the plasmodium is apt to be very numerously present. It has been noticed in towns that when much digging and turning over of earth has been going on, malaria exhibits a tendency to prevail.

Entering the human body through the lungs, the plasmodium seeks a roosting place in one of the red corpuscles of the blood. These corpuscles are in shape flat round discs, bearing a curious resemblance under the microscope to pieces of money. How essential their well-being is to health, everybody knows. The parasite having taken up its residence in one of the corpuscles, proceeds to multiply, forming a little colony. The colony feeds upon the material of the corpuscle, which thus becomes disorganised and is finally destroyed, so that the hostile germs are set afloat in the blood. At the beginning they were merely bits of protoplasmic jelly, without any particular shape, but now they become free swimmers and have developed long hairlike oars to paddle about with. Each one has three such oars radiating from its body. Thus they make their way through the veins and arteries, following the tide of the circulation.

Of course, it is not possible that this sort of thing should go on to any considerable extent without seriously affecting the health of the individual. The latter is attacked by chills, alternating with fever. Quinine and other remedies destructive to the parasites relieve these symptoms. However, if the patient continues to be exposed to the absorption of the germs in a malarious region, medicines will cease to have effect. The blood, invaded by hordes of plasmodia, becomes filled with disorganised red corpuscles, and nature gives up the fight, death ensuing.

Now that medical science knows precisely what it has to contend against in the treatment of this hitherto mysterious disease, it may be able to find more effective remedies. Already the discovery has enabled physicians to correctly diagnose many malarial cases which have a way of counterfeiting typhoid fever and other troubles. In such instances the presence of the plasmodia in the blood, readily ascertained by the microscope, settles the question. Besides, if one must suffer, it is a great comfort to know what is gobbling one up.

At the end of July last, there were 63,500 electric lamps—incandescent and arc—in use in Paris. At the end of March, 1891, the number was 22,000, showing during a period of 16 months an increase of 41,500.

ANSWERS TO CORRESPONDENTS.

Questions to which answers are desired in this column must NOT *be marked "Science Queries and Answers."*

S. R.—Bichromate batteries are charged with a saturated solution of bichromate of soda, to which one-tenth part of its volume of sulphuric acid is added.

J. S.—You can buy the glass vessels, which are known as beakers, at such a low price that it would hardly be worth while to make them as you suggest from glass bottles. With sufficient manual dexterity, that is to say, with sufficient practice, you would, however, be able to cut the bottles very readily in the following manner:—Tie firmly a couple of pieces of string in the form of rings, separated by about 1/16 inch on the circumference of the bottle. Between these rings, as guides, wrap once round the bottle a piece of flexible wire or string, and while holding the ends taut, draw it rapidly backwards and forwards so as to cause friction and local heating of the glass. Quickly remove the single turn of loose wire, and plunge the bottle in cold water when it will break in two at the heated portion.

J. P. Wilcox.—Fuel gas, composed of about fifty per cent. of combustible matter, hydro-carbon oil, consisting largely of olefines, and ammonia are the bye-products obtainable in the manufacture of furnace coke. By the most successful process hitherto employed, we believe that about 10,000 cubic feet of fuel gas, 2 gallons of oil, and 2 lbs. of ammonia as sulphate have been recovered in the coking of a ton of coal.

S. Philips.—Siemens' producer gas, as commonly used for iron puddling furnaces, contains about forty per cent. of combustible matter. Your furnace would not be any improvement on those now in use, but rather the reverse, and we cannot recommend you to patent it.

Anxious.—Perhaps the reason why your gas engine does not work satisfactorily is that the air and gas are admitted in wrong proportions. As you say that you do not understand the mechanical arrangements, we should suppose that your best plan would be to call in the assistance of someone who does. Or you might have the burnt gases from the exhaust pipe examined by an analyst, who would then be able to give you accurate information as to the conditions of combustion.

E. Marchand.—We are willing to admit that every new composition *of note* secures a trial by the authorities; but that does not affect the gist of the argument advanced.

A. Mitchell.—Gillmore's "Treatise on Limes, Hydraulic Cements, and Mortars" (Van Nostrand) and Faiga's "Portland Cement for Users" (Crosby, Lockwood, and Co.) may be found useful. Such receipts are scattered through a large number of different books on allied subjects. Let us know your specific requirements, and we may be able to furnish you with a good receipt.

F. Bourne.—We are obliged for your letter, but owing to want of space we cannot at present make use of the communication.

W. Fletcher.—We regret your disappointment. The answers published are, however, those we consider most generally interesting. A very great number of answers is received; whence many accurate and well written paragraphs are necessarily among those which we pass over.

Liquid Glue.—"In weaker glue" should have been added at the end of the reply on p. 269. It must also be mentioned that the consistency of Venice turpentine is not always uniform. Does your Venice turpentine smell of ordinary spirits of turpentine? If so it is probably factitious, and will not answer. The following receipts for liquid glue avoid the use of acid. Put 4 oz. lump sugar and 1 oz. slaked lime in half-a-pint of water. Heat to 75° C. and shake thoroughly. Allow the mixture to stand for a few days, shaking it frequently. Then, after settling, pour off the fluid from the sediment of lime, and boil it with 3 oz. glue. Or dissolve glue to saturation in nitric (not nitrous) ether.

G. S. H. Baultt-Hamilton.—Thanks for your offer, but we are unable to avail ourselves of it at present. Will keep your name before us for future reference.

Charles Leni.—Thanks for your appreciative remark. See "Gleanings of the Globe."

Thos. Collingwood.—We agree that the clocks you mention may be very accurate timekeepers, but we cannot assent to your suggestion that we should give the maker a free advertisement, because, as you say, "he does not advertise."

Explosion.—Your bottle of ether should be closely stoppered. You will find it, however, almost impossible to prevent some evaporation. Keep it, therefore, in a cool and well ventilated place, where any ether vapour that may happen to escape, will not accumulate in dangerous quantity. You would not, of course, put the bottle in the sun; but to wrap it up as you suggest would be unnecessary.

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Good collection of birds' eggs for sale, 166 in number, 113 species. Charles Goulter, Bearfield-road, Kingston, Surrey.

Galvanometer, in mahogany case, 5s. 6d. Thornton, 50, Walton-street, Chelsea.

Wanted, whole-plate camera set, good condition and cheap. Lama, 2, Putney Bridge-parade, Putney, S.W.

Wanted, good student's microscope, cheap. Approval necessary. M., Halstead House, Southend, Essex.

Object glasses, 4in., 3, 2, 1, 2/3, ¼, ⅛, 1/12, immersion. double nonpieces, Collins, Webster condensor, polariscope, parabolic reflector, all latest improvements, and in first-class condition. Price £50; cost £100. Tedmas, Plumtre-street, Nottingham.

Wanted, ½-in. objective, must be first-rate maker. Trower, Redhill.

Pair telephones, worked circuit 2 miles, 7s.; or exchange for small motor. Edward Hathway, Telegraph Department, Post Office, Bristol.

Electric vacuum tube, rotator, with 2 1-pint bottle cells, coils, and 8 tubes in first-rate order. Cost £3; price 25s., or offers. Deposit. S. Biscoe, Oakhanger, Godalming.

Three inch prismatic compass, in leather case, 15s. Approval. S. Cooper, Harrington, Northampton.

Three larvæ breeding cages, 18in. by 17in. by 9in., specially made, 4s. each. Pennell, 5, Gordon-street, W.C.

Nice pair opera glasses, in case. Cash 10s., cheap. D., 11, Bellevue-terrace, Brislington, Somerset.

Powerful microscope and objects, ¾in. and 1in., by Newton Cost £15; low price, or exchange safety. P., 30, Bythorn-street, Bow.

Splendid pair bullock's horns, nicely polished, 25s. Apply A. Ticehurst, Cade-street, Heathfield.

Aneroid barometer, new, round oak case. Cost 25s.; take 17s. 6d., bargain. Lea, Tontine-st., Folkestone.

Wanted, perfect skins or stuffed specimens of hawks or eagles. R. T., Court-place, West Monkton, Taunton.

Wanted, good set architect's drawing instruments M., 24, Abercorn-place, N.W.

Lancaster's ½ instantograph, 3 dark slides, tripod, strong case. Watkin's exposure meter, dishes, etc., good condition, 70s. Particulars, Atkins, Riverside, Rickmansworth.

Ostrich's egg, 5s.; emu's egg, 6s.; Canadian goose's egg, 2s.; perfect condition. Blaxley, 57, Regent's-road, Leicester.

Red shouldered hawk, grand specimen, cases 20in. by 16in. by 9in.; falcon hawk, mounted alike, suit hotel or nobleman's hall. 30s. pair; offers. 7, Berachah-road, Torquay.

British birds' eggs. Collection of 56 species, nearly 500 rare eggs. Offers to Goulstone, Bishop-road, Anfields, Liverpool.

Quarter-plate Facile hand camera, landscape lens, perfect condition; also walkingstick tripod. Offers. F., Ravensgill, Harrowgate.

Wanted, disarticulated skull, complete, lowest cash. Maitland, 136, Great Portland-street, London.

Globe, terrestrial, mahogany stand, perfect condition, cheap. Rees, 37, Peel-street, Birmingham.

Large poplar chrysalis, 1s. 6d. doz. Exchange Cynthia, Pernyi. Herr White, 33, Shelgate-road, Clapham Common.

Wanted, good Morse telegraph instrument, cheap. T., 44, Park-street, Cambridge.

Chipper, rapid doublet lens, 4½ focus, F8, for hand. cameras, adjustable focus, flange, handy for copying. Chipper Exchangeries, Highgate-hill.

Half-plate book form, dark slides, fitting Lancaster's instantograph, 5s. 6d.: ¼ ditto, 3s. 9d. Other patterns fitted. Approval. Chipper, Highgate-hill.

Whole-plate double extension camera, every improvement, 3 double slides, rapid rectilinear lens, Waterhouse stops, ash tripod, £6. Chipper, Highgate-hill.

Magic lantern, portrait front lens, 4in. condenser, Russiate iron lamp, 3 2in. wicks, 26s. 6d. Approval. Chipper, Highgate-hill.

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SCIENCE NEWS AND NOTES.

"It is not work that kills men; it is worry. Work is beautiful; you can hardly put more upon man than he can bear. Worry is rust upon the blade."—HENRY WARD BEECHER.

The Influence of Tobacco.

and nicotine on student development was dealt with in a very able paper, by Professor Seaver, published in our columns a few weeks since. A new phase of the question now comes before our notice, although, of course, not for the first time. We refer to the prophylactic or disease-preventing advantages claimed by tobacco smokers. The discussion is raised by Dr. V. Tassinari, of the Institute of Experimental Hygiene attached to the University of Rome. He recalls the fact that in the eighteenth century, and even in the seventeenth, a certain number of medical men—Willis, Dimerbrock, and others—advised their friends to smoke in times of epidemic. At Strassburg, in 1842, Ruef called attention to the fact that the workers at the tobacco manufactory were exempt from almost all the prevailing epidemics. Pécholier, in the *Revue d'Hygiène* (1883 p. 523), proclaimed the same opinion, and Dr. Walter Cock of Texas was rash enough to recommend, in 1889, the use of tobacco as a preservative against phthisis. An American dentist—Dr. Miller of New York—made experiments in 1884 with the smoke of tobacco on micro-germs of dental caries, and declared that the results were satisfactory and conclusive. Dr. Vassili, of Naples, employed in 1888 a small balloon, which he lined internally with a layer of gelatine containing cholera bacilli. He found that by drawing through this balloon the smoke of from one to four cigars—the number of cigars required depending on their strength in nicotine—the gelatine was completely sterilised.

These Experiments have been Repeated

by Dr. V. Tassinari, who maintains that the smoke of tobacco either entirely destroys, or in any case retards, the development of the bacillus of cholera, of anthrax, and of pneumonia. Dr. Tassinari has published twenty-one charts indicating the action of tobacco on various known microbes, according to the nature of the tobacco and the amount consumed. The latter varied from one to six grammes, smoked in from ten to thirty minutes. The bacilli of Asiatic cholera and that of Friedländer (pneumonia) were always completely destroyed, no matter what sort of tobacco was used. The bacillus of anthrax resisted better, and that of typhoid was hardly affected by the smoke. As a practical result of these experiments Dr. Tassinari insists on the utility of smoking as a means of preventing the decay of teeth. He seems to imagine that women suffer more from dental caries than men, and attributes this difference to the fact that but few women smoke. The *Lancet* claims that these experiments are not conclusive. There is a great difference between the sterilising of microbes in nutritive gelatine and in the human being. No one doubts the antiseptic qualities of nicotine. Sulphurous acid is also an antiseptic, but it still remains to be seen that London fogs and London smoke save the metropolis from zymotic disease.

The Climatology of Old Age

is roughly summed up as follows by a well-known medical authority, whose views now appear for the first time. Elderly people in general do well with equability and moderate warmth; they bear cold badly; they benefit by abundant sunshine. The high altitudes are very rarely suitable to them, and are usually decidedly injurious; they do best in level places, where there is abundant shelter. They may or may not benefit by the seaside or a sea voyage, but these measures cannot be recommended with at all the same confidence as in the case of children. Most of these principles become almost obvious upon a little consideration. The failing vitality, by which we mean impaired vigour of circulation, assimilation, and excretion, which characterises advanced years, and the special maladies most frequent at that time of life, such as rheumatism, cardiac disease, gout and renal affections, serve to determine the climatological problem. Moderate warmth with fair equability, abundance of sunshine with adequate shelter, and level walks, evidently meet the most obvious indications called for by these affections. The points certainly convey some very useful hints to those of our readers whose years have entitled them to the necessary leisure to attend to such details.

Sun Spots and the Aurora

are phenomena that seem to interest a considerable section of our readers. Mr. E. Kennedy sends us some interesting particulars of a magnificent display of the aurora borealis seen in New York latitude on the 13th ult. Telegrams

from various points show that the phenomenon stretched over a great belt of territory from Iowa to the Atlantic. A peculiar effect was produced on the telegraph system, and for intervals of three or four minutes at a time the wires were so surcharged with atmospheric electricity that between New York and Albany it was possible to send messages without the aid of the regular batteries. The current, however, was intermittent and the effect unsatisfactory. For nearly two hours it was impossible to transact ordinary business with any degree of exactness. The aurora seemed to occupy the whole of the northern heavens, and was beautifully marked, the colouring being clear and distinct. People at first feared that a great fire was raging. Professor Rees, of Columbia College, in the course of an interview, gave it as his opinion that the phenomenon was probably due to present disturbances on the sun, a view which was shared by other scientific men. Mr. Kennedy's observations have led him to the conclusion that these phenomena are always followed by intense cold, while intense heat appears more often in the sun spot years. As this appears to have been a remarkable year for both phenomena, we may expect a visitation of both extremes. Anyhow, our readers will no doubt have an opportunity of observing all this for themselves. We may mention that the aurora has been most brilliant within the past few days in Sweden and Russia, where the telegraphic arrangements were affected in the same way as in America. The derangements are due to the earth currents which are the usual accompaniments of the aurora.

The Earth's Magnetism

is a force of which the precise derivation has long been a puzzle to scientific men. Our attention has just been directed to a paragraph in the *Referee* of 14th ult., in which a most interesting and ingenious theory of this magnetisation is referred to. The writer of "Our Note Book" thinks that in the rotatory motion of our earth we find a sufficient explanation of the "swirls" in spacial ether by which, as he affirms, magnetism may very probably be constituted. This writer evidently regards the universal medium as a homogeneous fluid, and finds the cause of the magnetic "swirls" in the friction of ether, bound or carried round with matter, against ether free in space. He does not hint at the possibility that the structure of the ether may be dual. But if, as some believe, this is the fact, we might still discover some foundation for the "friction" theory of magnetisation by supposing that matter has a greater attraction for one of the ethers or for one of the "electricities" than for the other. Thus it would be possible to conceive the frictional rotations of the less attracted ether as taking place consistently with the reciprocal motion of the more attracted ether—an idea that would be in harmony with the received notions of molecular electric currents. What strikes us most forcibly in connection with the suggestion of the *Referee* is, however, that

It Could be Proved

or disproved by an experiment that could be carried out with little difficulty. Suppose a little arm or roller of hardened steel to be rotated, by mechanical means, at a very high rate of speed. It should acquire, according to the theory of the *Referee*, some trace of magnetism, and this magnetisation, owing to the quality of the steel, would persist, and could be detected after motion had ceased. We have ourselves seen a little bar cutter rotating at the rate of 500 turns per second. But this speed of rotation might be very far surpassed by that of a steel bullet fired from a suitably rifled gun. Indeed, our argument is that by these means a circumferential velocity at least comparable with that of the earth might be easily obtained. It is of interest to compare the relations of a solid vane thus rotating and of the earth itself with the surrounding atmosphere. As, in the former case, we have not gravity to drag round a miniature atmosphere bodily with the vane, it is not unreasonable to suppose that, when the rotational velocity exceeds the average velocity of the atmospheric "molecules," a state of great compression may be induced before and of almost perfect "vacuum" behind the solid vane. Should it be possible to carry out a full investigation of this phenomenon, the actual velocities of the fastest and slowest of the jostling molecules in gases might be determinable.

Objections

remain, however, to be mentioned in connection with the ingenious theory of the *Referee*. Without, at the moment, advancing a rival "explanation" of our own, we would remark that the earth's magnetism is such as would be induced by currents of electricity having (as the direction of currents is commonly understood) the same direction as the motion of points in the circumference of the earth. But why is it necessary to seek a force maintaining the polarity or magnetisation of the earth, other than the same force or rather the same condition that conserves the far more intense polarity of a common steel bar magnet? We are under the impression that the molecular currents constituting magnetism are unimpeded, and therefore constant without the application of sustaining force. The relative positions of the individual molecules, by which is determined what we know as the magnetic state, can be modified by the neighbourhood of current electricity—for instance, by the well-known earth currents—or again by the direct application of mechanical distorting forces, of which, perhaps, we have some pertinent examples in the gradual contraction of the earth's crust. This might also be expected to yield through magnetic phenomena some indications of the periodic stresses and strains to which it is exposed by its remarkably complicated motion through a somewhat irregular field of gravitational force.

The Evidence in Favour of Light

being a vibratory disturbance in the ether of electro-magnetic nature is such as almost to amount to demonstration. When this is generally accepted, the whole domain of optics and radiant energy will be enrolled as one department and property of electro-magnetic physics. Light, although seemingly so unsubstantial and powerless, is labour, and requires force to generate it. Every ray of light that vibrates in space is full of force and energy. Every ray that comes to us is the product of chemical labour applied to distant stars by elements such as oxygen, carbon, hydrogen, etc., in the fierce tumult of chemical union and decomposition.

A Most Remarkable Discovery

of what is termed "fossil flour" has recently been made in the State of Maine, U.S.A. It is said to be of such purity as to arouse the wonder of the best analysts. An investigator of the properties of this new earth was immensely impressed by its wonderful faculty for resisting the action of acids, alkalies, oils, and especially by its remarkable quality as a non-conductor of heat. A simple test of this latter quality was to take an inch cube of the material and place it on a bar of iron. The iron bar was then put in a blacksmith's forge and heated until it was melted away from the cube of earth. So little did the heat

penetrate this cube that one could easily place the fingers upon the upper part of it without inconvenience from the heat. This fossil flour is almost as white as oxide of zinc. It is so light in weight that a flour barrel of it in its natural condition will not weigh over 50 lbs. It is, as we have already stated, absolutely unaffected or unchanged by any sort of mechanical manipulation, by acids, alkalies, or heat. As it is mined, it comes out of the ground a pure white powder, so fine that it cannot be ground any finer. A careful analysis of it shows about 95 per cent. pure silica. This kind of earth is said to have been used in Europe very largely for a varicty of purposes; one of the most curious of which was is Sweden, where the poorer classes mined it and mixed it with wheat flour, in order to make bulky loaves of bread, not for sale, but for their own eating.

The Old Question of Adulteration

is thus again aroused, but we do not think our readers have much to fear from it in this form. Although undoubted bread and baking powders are adulterated with alum, and the latter even with ammonia. Such powders not only undermine the system, but it is pointed out that ammonia taken into the system in even infinitesimal dosesday after day, imparts to the complexion a sallow and blotched appearance. We were recently speaking to a distinguished hygienist on this subject, and he considered that the ill effects upon the system of food raised by alum baking powders are the more dangerous because of their insidious character. It would be less dangerous to the community were it fatal at once, for then such food would be avoided; but their deleterious action, because impereeptible at first, is no less certain. The puckering effect which alum has when taken in the mouth is familiar to every one. Physicians say this same effect is produced by it upon the delicate coats of the stomach and intestines. The sale of these impure goods, is, of course, extremely limited, owing to the stringent laws that have been enacted to prevent it.

The Preservation of Health

depends to a greater extent than is commonly supposed on the detection of the first indications of disease. Slight feverishness is the precursor of many most serious illnesses, which, if the premonitary symptom were recognised, could often be averted by the simplest of means. Many a doctor's bill and many a fatal illness can be avoided, therefore, by intelligent heedfulness of the temperature of the blood. It is so easy to ascertain this temperature by inserting a clinical thermometer in the mouth or under the armpit that we have been accustomed for a long time past to keep such a thermometer in the house and to make frequent use of it. We recommend the practice to our readers, and we are pleased at the same time to inform them of an improvement in "clinicals" by which the sensitiveness of the instruments has been greatly increased—the old-fashioned and rather tiresome four minutes test being reduced to three-quarters of a minute only. This instrument has been patented by Mr. J. J. Hicks, of Hatton-garden, who is probably the largest manufacturer of clinical thermometers in the world. We have examined the technical specification of the invention which is filed in the Patent Office. It describes a most ingenious method of glass making by which the length of the bulb portion of the instrument is decreased and the contraction for the "indestructible index" is brought down almost to the mouth of the bulb. By these means the advantage of a more open scale is attained while the distance to which the instrument must be inserted in the mouth (for example) to insure accurate readings is lessened. We have been presented with a specimen of the new thermometer by Mr. Hicks, and find all the claims made for it to be amply sustained.

The Importance of Modern Photography

as applied to microscopic objects is forcibly brought out by the following remarks made by Prof. Robert Koch, the eminent bacteriologist, who employs photography with great success to bring out the most minute parts of organic and inorganic bodies. Prof. Koch likens the negative plate to a human eye not blinded by a sharp light nor tired out by long-continued examinations. "The negative," says Prof. Koch, "frequently shows very fine bodies and parts, which are afterwards discovered by the microscope on the object itself, but only after very hard work and under the most favourable conditions regarding light, etc. Accurate measurement of but faintly visible objects is almost impossible under the microscope, but on the finished negative the task is rendered comparatively easy. The photographic picture of a great many objects is frequently of more importance than the object itself. If I gave to somebody a prepared specimen for viewing certain parts of the same under the microscope, for instance, lymph vessels containing bacteria, then I am not certain that the party has found the right spot, and if this is the case, I am not positive that he is viewing the part under the same light and conditions as I did. A photograph, however, gives the microscopic picture exactly in the same light, the same enlargement, etc., as I viewed it at the time of focusing it. It is very simple to explain the photogram to a number of persons at the same time, as one can point with the finger to a particular part, or measure it with the compass, or compare it with other similar photographs placed alongside of it, in short, you can do almost anything in order to come to an understanding over a disputed part."

The Source of the Nile

is said now to have been discovered by Emin Pasha in his wanderings from Lake Victoria to Lake Albert Edward. But before giving way to unreserved jubilation, the Royal Geographical Society and African experts will wait for a detailed account of what he has actually done. Emin Pasha certainly has not been as far as 4° south latitude, where the Kifu, the river in question, is said to rise, so that its southern course is still conjectural. But that he has traced this Kifu to the southern shore of Lake Albert Edward may be accounted as all but certain. This upsets much of the hydrography of the region between Lakes Victoria, Albert Edward, and Tanganyika. It sweeps a conjectural Lake Kifu and probably Stanley's Nyanza off the map. It greatly diminishes the length of the Kazaera, which flows into Lake Victoria, and it probably does the same with the Russia, which flows into the north end of Lake Tanganyika. There are, it should be added, several streams which flow to the southern shore of Victoria Nyanza, one of which may come from a more southerly latitude than the Kifu. Indeed, Stanley in 1876 thought he had discovered the most remote source of the Nile in the Shimerjee, which, as he conjectured, came from at least 5° south of the equator. But, so far, this conjecture has not been confirmed. Whatever else Emin may do on this curious pilgrimage of his, he is likely to be able to throw further important light on the source of the mysterious Nile.

All back numbers of "Science Siftings" may be obtained either direct from the office, or through any respectable newsagent.

GLEANINGS OF THE GLOBE.

A SERIES of very interesting lectures on science subjects is being given at the Victoria Hall, Waterloo-road, on Tuesday evenings.

THE third Congress on anthropology in relation to crime will be held at Brussels from August 23rd to September 3rd next.

IT is claimed by Dr. Arabella Kenealy that "the women who take the most actively energetic part in public affairs are the mothers of the most weakly and puny children."

THE white efflorescence which often appears on the face of brickwork may be removed by washing the surface with a sponge dipped in a weak solution of muriatic acid.

A PASTEUR INSTITUTE was opened recently at Saigon, Cochin China, under the auspices of the French Government. The work of the institute will extend over the whole field of microbiology.

THE successful culture of the camphor tree in Florida, where it is said to flourish so vigorously and grow so rapidly, suggests the probability that in a few years time there will be more camphor than orange trees in the country.

THE lower part of the clouds range in elevation above the earth's surface from one to five miles. The cirrus clouds, which are feathery in appearance, are usually the highest, and the nimbus clouds, from which rain comes, are the lowest.

INFLUENZA is not confined to human beings. A violent epidemic of the disease broke out recently among the monkeys in the Central Park, New York, and all the animals attacked succumbed to the disease.

PEDESTRIANS, either amateur or professional, who suffer from sore feet after an unusually long walk, will experience great relief from soaking the feet once or twice a week in a half pailful of hot water, to which a piece of nitrate of potassium, the size of a small walnut, has been added.

OXYGEN is the most abundant of all the elements; it composes at least one-third of the earth, one-fifth of the atmosphere, and eight-ninths by weight of all the water on the globe; it is also a very important constituent of all minerals, animals, and vegetables.

A FOG bell worked by electricity has recently been placed at the port of Ravenna, in Italy. The bell is struck by means of a small magnetic electromotor, current for which is supplied by a Daniell's battery, in the lighthouse about a mile away.

THE French are now painting their war vessels a dull, sulphurous-grey, exactly the colour of smoke as it arises from cannon. They say this colour has the advantage of being as illusive and indistinguishable in fogs and sea mists and darkness as during the smoke of battle. It is more baffling to the search light than any other tint.

THE first application of jewels to watches to diminish the friction of the pivots was made by Nicholas Faccio, an Italian, in 1704, his patent taken out in England bearing the date of May 11th of that year. Both precious and common stones were used by him, and were also placed in clocks. In one portion of the patent watches and clocks are referred to as engines.

GERMAN engravers harden their tools by heating them to a white heat and then plunging them into sealing wax, continuing the operation until the tool cools. By this method, the steel becomes almost as hard as a diamond, and when touched with a little oil, is excellent for engraving or for drilling into other metals.

THE Dutch Government is about to work the rich coal mines near Padang, in the island of Sumatra. It is calculated that from two to two and a half million tons of coal can be extracted every year. The coal is at least equal in quality to European coal, and it is expected that it can be sold commercially on the Continent at from 17s. to 18s. a ton.

WE learn that the scheme for providing a tubular electric railway for Paris is progressing satisfactorily. The commission appointed to report from the technical point of view upon the proposed plans have unanimously adopted them. One of the numerous stages necessary for the inauguration of the line from the Bois de Boulogne to Vincennes has thus been successfully passed.

THE typewriter has hitherto been supposed to be an English invention, subsequently developed by the Americans; but a patent has been discovered in the French archives which gives the credit of originating the idea to a Frenchman, M. Pogrin, of Marseilles, who devised and illustrated his apparatus as far back as 1833. "With a little practice," says the author "one can write as rapidly with the ktypographic pen as with the ordinary pen. I have called it the ktypographic machine or pen, because it prints by striking. It will give birth to a new art."

MM. FABRE and Andoyer photographed the eclipsed moon at Toulouse Observatory on November 13, 1891; and some of the pictures obtained were exhibited by them at the meeting of the Paris Academy of January 11, with a note on the method of production. Collodion-bromide and collodion-chloride plates were employed, both kinds being treated with eosin and cyanin to render them orthochromatic. The former kind of plate was found to be relatively more sensitive to red and yellow rays than the latter, although both were stained with the same dyes. It is proposed, therefore, to use collodion-bromide orthochromatic plates to obtain photographs of Mars, Jupiter and the red spot, and coloured stars.

TIME is bought and sold in America, though not at the exorbitant rate proposed by the sovereign who offered millions of money for an inch of it. The Government furnishes correct time free to its citizens, but they must get it at the Naval Observatory in Washington. This is manifestly impossible for most of them, so the Western Union Telegraph Company daily forwards it to every part of the country. Three minutes before noon all general business is stopped and direct connections made with the capital. At the moment the sun crosses the meridian a single flash of the electric current announces the fact all the way to the Pacific Coast. It costs only 15 dols. (about £3) a year in America to have your clock set every day at noon by telegraph. Here is a chance for English enterprise!

SCIENCE QUERIES AND ANSWERS.

A prize of two shillings and sixpence will be awarded for every interesting question asked by our readers and published in this column, and five shillings will be given for every answer published. In all cases when a similar question or reply is sent in by two or more correspondents, the award will be given to the one whose letter is first opened, provided the subject is properly treated. Questions asked by correspondents and not replied to by our readers, may, if of sufficient interest, be dealt with Editorially.

Rules for Competitors.—(1) Only one question may be sent each week, but any number may be answered. (2) Write on one side of the paper only. (3) Envelopes must be marked "Science Queries and Answers," and must arrive not later than the Monday following date of publication.

The following are Answers to Queries published in No. 18.

31.—Is it a fact that plants thrive better in a frame or greenhouse that is glazed with blue or violet glass, so as to filter out all but the chemically active rays of light ?

No, it is not. The "chemically active rays" in horticulture are totally distinct from those blue and other rays now so familiarly known as "actinism." Only light of between 40 and 69 ten-thousandths of a millimetre, in wave length, is available for the decomposition of carbonic acid and water by means of chlorophyll. The decomposition takes place most rapidly in light of 59 ten-thousandths wave length (yellow light). There is not, however, under ordinary circumstances, any material advantage to be gained by interfering with the conditions of lighting established by nature. If some fluorescent medium could be so applied as to convert the light of higher into light of lower refrangibility, a real advantage might be gained. It should be remembered, however, that the effect of warmth is to stimulate the growth of plants, even in the absence of proper nutrition; in other words, that growth takes place without the presence of light, and, therefore, without the assimilation of carbon. Thus structural development may easily outrun nutrition—a tendency which it has been found to be the part of blue and violet light to keep in check. It will be readily understood that, in a case where artificial light is used to force the growth of plants by night, a yellow screen might be found almost necessary. Again, it would be an interesting subject for experiment to find out the effect of stopping *radiant* heat, by means of alum cells.

32.—What is the meaning of the term "one-man power," as applied to small gas engines ?

It is probable that, as a rule, the meaning attached to this expression is even more vague than the interpretation given to the horse-power, by manufacturers of steam engines. An ordinary labourer performs about 400 foot tons of work per day of ten hours. Some average figures are, for paviours, 360 foot tons; for hodmen, 370; and for a man working the "box lift," that is, raising his own weight by a ladder, about 410 foot tons per working day. The figures given correspond to about 40 foot tons per hour—or say about one-twentieth of a horse power. But when the duration of the work is shorter, it can be done, of course, at a much greater rate of speed. Thus, for example, in a boat race, work equal to 4 foot tons per minute may be done by one man during a period of about seven minutes. And a labourer carrying a heavy load for half a minute, at a speed corresponding to 8 miles per hour, may do work at a rate equivalent to 9 foot tons per minute—over half a horse-power. It may be of interest to remark that all these forms of labour involve the activity of nearly every muscle in the human body. Expressed as foot pounds of work done per minute, and divided by the number of ounces weight of muscle concerned, as nearly as can be guessed, they give the efficiency of this human muscle as 7½ when climbing a ladder, 15 when rowing, and 35 when climbing with a load.

33.—Is there any chemical test by which living protoplasm can can be recognised, and distinguished from dead matter ?

Living protoplasm is distinguishable owing to the presence in it of aldehyde, which reduces metallic silver to a finely divided black condition, from a very dilute solution of the nitrate. To make the test solution, mix half a pint of distilled water containing 1 grain of nitrate of silver with another half pint of water containing 5 grains of caustic potash and 20 drops of liquor ammonia. Immerse the cellular matter to be tested without loss of time, and leave it in the dark for about 12 hours. The presence of living protoplasm can now be easily recognised by the microscope, the cells being stained black. Much assistance can also be obtained from ordinary staining solutions, as the alcoholic solution of iodine, in examining protoplasmic structures.

34.—Setting aside all astronomical observations, what is the simplest proof of the rotation of the earth ?

The simplest proof of this rotation is the deviation eastward of a falling body; such, for instance, as a ball of metal falling to the bottom of a deep mine. By means of a plumb line, which, of course, hangs vertically, this deviation of the falling body can be easily shown. It has been measured in a 158 metre shaft at Frisburg as 28 mm. Theory would indicate, in this case, a deviation of only 26·6 mm., but, of course, any such variations can be readily accounted for by casual disturbances of the air, and other imperfections and errors of experiment. The deviation at the equator, in falling a depth of 100 metres, is estimated at 33 mm. From such experiments as that described, the enormous circumferential velocity of the earth could, if necessary, have been easily calculated.

35.—What is the upper limit of frequency, beyond which sounds cannot be distinguished by the ear ?

It is usually stated to be about 40,000 per second. This is, however, entirely a question of intensity. It would be absurd to assert that 50,000 blows of a steam hammer or hammers, if delivered successively in one second, would not be appreciable as sound to human ears.

36.—What is the simplest illustration of the principle, discovered by Archimedes, that all bodies immersed in liquid suffer a loss of weight equal to the weight of the liquid they displace ?

Drop a grape into a tumbler freshly filled with champagne. The grape falls at once to the bottom of the glass, where bubbles of carbonic acid gas, evolved from the champagne, collect upon it. Before long, the volume of the grape, by reason of these adherent bubbles, will become equal to, and eventually greater than the volume of an equal weight of liquid. The grape then rises to the top. By giving it a jerk with a fork, the bubbles which buoy it up are broken or scattered, and the grape sinks, but only to rise again, after a little time, in the same manner. This interesting experiment, it will be observed, requires no special apparatus of any kind whatever.

QUERIES.

Replies to the following Queries must reach the Office by Monday at latest; and those selected will be published in the issue after next.

43.—What is the size of the red blood corpuscles ? How many are contained in, say a cubic inch; and how is this number determined ?

44.—What is the maximum power of human muscle?
45.—Is there any method of photographic printing that avoids the use of poisonous chemicals?
46.—What is the relative luminosity of sun, moon, and stars in clear weather?
47.—What is the simplest astronomical proof and illustration of the laws of gravity?
48.—At what rate is work done by the involuntary motion of the heart, as compared with that done by machinery?

SHALL WE EVER FLY?

Above us is the great aerial ocean, stretching over all lands, and offering an always open way to them, yet a way that has never yet been thus trodden. Can it be that the power we have always lacked is at last found, and that it only remains to learn to guide?

Let me, says the Secretary of the Smithsonian Institute, in answering, compare the case to that which would present itself if the actual ocean had never been traversed because it was always covered with fields of thin ice, which gave way under the foot, which, indeed, permitted vessels to be launched and to float, but which compelled them to move wherever the ice drifted. Such vessels would resemble our balloons, and be of as little practical use; but now suppose we are told "the ice, which has always been our obstacle, may be made your very means of transport, for you can glide over the thinnest ice, provided you only glide fast enough, and experiments will prove not only how fast you must go to make the ice bear, but that it is quite within the limits of your strength to go with the requisite speed." All this might be true, and yet if no one had ever learned to skate, every trial of this really excellent plan would probably end in disaster, as all past efforts to fly have done. Indeed, in our actual experience with the air, men have come to the same kind of wrong conclusion as would have been reached in supposing that the ice could not be traversed, because no one had the strength to skate, while the truth would be that the man has plenty of strength to skate, but is not born with the skill.

The simile is defective so far as it suggests that man can sustain himself by his unaided strength on calm air, which we believe to be impracticable; but it is the object of these experiments to prove that he has now the power to sustain himself, with the aid of engines recently constructed, and by the means we indicate, as soon as he has skill to direct them.

If asked whether this method of flight will soon be put in practice, we should have to repeat that what has preceded is matter of demonstration, but that this is matter of opinion. Expressing then, a personal opinion only, our authority answers, "Yes." It is hardly possible that these secondary difficulties will not be soon conquered by the skill of our inventors and engineers, whose attention is already beginning to be drawn to the fact that here is now a field open to them, and though we have not experimented far enough to say that the relations of power to weight here established for small machines will hold indefinitely large ones, it is certain they do so hold at any rate far enough to enable us to transport, at speeds which make us practically independent of the wind, weights much greater than that of man. Progress is rapid now, especially in invention, and it is possible—it seems to us even probable—that before the century closes we shall see this universal road of the all-embracing air, which recognises none of man's boundaries, travelled in every direction, with an effect on some of the conditions of our existence which will mark this among all the wonders the century has seen.

The latest English news on the subject of flying comes from Coventry. Messrs. Shaw and Sons of that town have just completed for Major Moore, R.E., a flying machine, which is based on the experiments made by that officer in India. The wings measure 17 ft. 6 in. by 8 ft. 6 in. in the widest part. For the present they are covered with calico, but, when attached to the box and electric motors, will have double woven silk, specially prepared, stitched on; the silk will cover the box as well as the wings. A closer inspection shows how carefully the anatomy of the flying-fox has been followed. There are seven bones, leading off with two of 8 ft. and 10 ft. long, and finishing with one of 12 ft., and are manufactured of the best weldless steel tubes, with brass-bushed joints; each joint and bearing has been forged, and this is the work that has delayed the completion of the machine. The tips of the wings are flexible. The head is formed of a loop of steel tubing, covered with silk, continuous without break from the body and wings. The tail is of tapering tubes, in prolongation of the side tubes or upper edges of the box which forms the body. Returning to the wings, which are of concave shape, each will have a sweep of 24 ft., 12 up and 12 down, and are expected to make 50 strokes per minute. They are to be thoroughly tested, and when supported from the hinge only will have to bear a distributed dead load of 4 lb. per superficial foot when the machine is turned on its back. Each wing is 120 lb. in weight, and the machine, with the box and motors, is expected to turn the scale at 700 lbs. The total cost of the machine will be about £1,000.

IS ELECTRICITY A MANUFACTURED PRODUCT?

This question has become of some importance in the United States, and is likely to cause no little trouble in the law courts there. It comes in the way of the authorities empowered to levy taxes, and they are called upon to decide as to whether electricity is a manufactured article. In the state of Pennsylvania there is a law of some years' standing which exempts from taxation the capital stock of manufacturing companies. The existence of this law brought an early test of the question as to whether electrical companies should be classed as manufacturers. One judge in a decision, which was subsequently affirmed by the Supreme Court, held that a company producing electricity was not a manufacturing company within the meaning of the law. He ruled that whatever electricity may be, it is manifestly and admittedly not a material substance, and whatever electric light companies do, they do not, in generating or evolving electricity, make changes or modifications by art or industry in the form or substance of material articles. They do not make wares of any kind nor reduce raw materials to a form fit for use. Another judge, in a decision on the same question, declared that nothing has been said to lead to the belief that electricity is a material substance, therefore its production, or generation, or evolution does not come within the authoritative lexicographic, scientific, or local definition of the terms "manufacture" or "manufacturing." Those connected with electrical interests claim that electric light or power stations should in law stand on the same footing as gas works. It is claimed that the production of something by the consumption of coal, whether it be gas or electricity, must be classed as manufacturing. So far, however, all decisions have been against the electrical companies, and tax must be paid upon the capital of these companies until they can show electricity is a manufactured article, unless in the meantime new laws are made to meet the development of a new force. We await developments of this question with some interest.

MIND AND MATTER.

The universe manifests itself to us in two ways only—by matter and by energy. And, although it is hard to conceive of the existence of energy without matter for it to act upon, it must be admitted that there is a distinct difference between the two classes of manifestations. A wheel in motion is the same wheel as when it is standing still, and yet there is a difference between the two cases. The moving wheel possesses something which we call energy, or that form of energy known as force.

The generally accepted theories of the present time refer all the means by which we receive knowledge of the outside universe, namely, sound, heat, light, electricity, etc.—to vibrations, or wave-like motions, either in the air itself or in a hypothetical substance called the *ether* and permeating the whole universe. That sound is due to vibrations of the air is certain. Whether the ether has an actual existence or not is doubtful; but it is certain that what are commonly called the wave-lengths of light, heat, and electricity are actual dimensions of *something* connected with the manifestations of those phenomena. These vibrations—as we may call them, for want of a better name—falling upon the nerves in our bodies convey the corresponding sensations to our brain, as messages from all parts of a city are conveyed over the wires to a central station. Beyond this we cannot go. How the brain perceives sensations, or how they become evident to our consciousness, is something which we do not, and probably cannot, understand, but must take for granted as a part of the great mystery of our individual existence.

But the fact that our knowledge of the outside world is due to wave-like or vibratory forms of energy of varying dimensions leads to some very interesting speculations. Space is full of such vibrations; from the sun and from every fixed star streams of radiant energy are constantly flowing, of every possible magnitude and variety. Up to the present time we have been acquainted with vibrations of a very narrow range of magnitude—approximately between three and eight ten-millionths of a millimetre, a millimetre being about one twenty-fifth of an inch. But it is probable that there are other vibrations, both larger and smaller, constantly surrounding us, which, if our organisms were adapted to receive them, might reveal to us forms of knowledge of which at present we have no conception. The researches of Lodge and Hertz have shown the existence of electrical wave-lengths varying from a few feet to even thousands of miles. Surely if there were in the human body any nerves which would receive and transmit such vibrations as the infinitely shorter vibrations of light and heat are now received, our conception of the universe would undergo a most radical change.

These considerations are not pure speculation and fancy. We have under our control the coarser atmospheric vibrations which produce sound, and by varying their frequency we can produce the highest or lowest notes at pleasure. There are certain limits in each direction beyond which our auditory nerves refuse to respond, but these limits are not the same in different individuals. Some persons will receive a low musical tone which to others with less perfect ears is either inaudible or is perceived as a confused noise. The shrill hum of certain insects is inaudible to many, and if there were no other persons in existence possessed of auditory nerves keyed up to a higher pitch, it would be assumed that these insects were incapable of producing sound. The sensitive photographic plate will receive and register forms of energy which in no other way could be rendered perceptible to our senses. It magnifies, as it were, the shorter wave-lengths, and thus manifests them to our less perfect senses.

That the so-called lower animals have the power of perceiving sensations unknown to man seems almost certain. The almost inaudibly shrill cry of the insects above referred to is evidently produced for some purpose. It is useful to those animals in their struggle for existence, and the impression it makes upon the nerves of their companions is doubtless very different from the way in which it is perceived by our coarser ears. The means by which bees, ants, wasps, and similar animals communicate with each other; the marvellous faculty of the dog in tracing his master, or of cats and pigeons finding their way home from long distances and over unknown roads, has never been explained, and can only be explained by supposing that they have sources of knowledge of which we can form no conception. If a wave of radiant energy miles in length is known to exist, why is it not possible that such waves may act in some way upon the perceptive faculties of a cat or a pigeon at that distance, just as the luminous vibrations from a distant lighthouse inform the sailor how to find his way to port? The subject is a fascinating—although a rather unsatisfactory—one to pursue.

The distinction between reason and instinct is an interesting one to consider in this connection. The tendency to certain actions, both in man and animals, is instinctive; that is, it does not depend upon instruction from others or from direct observation. It is as certain that animals reason as it is that man has instincts. A microscopic animal has been observed to turn away for an obstruction as it slowly moved along the glass slide, and even the amœba—the lowest form of life—seems to exert a certain power of selection in gathering his food. But, disregarding these perhaps doubtful evidences of reasoning power, the intelligence displayed by the dog, horse, monkey, or elephant in many cases cannot be distinguished from that which governs the actions of the wisest men. On the other hand, the functions of nutrition, reproduction, and self-preservation are as truly instinctive in man as in any other animal; and if an infant could be abandoned on an uninhabited island, and by any means survive, all these functions would be developed as perfectly as in an inhabitant of the most crowded city.

This brings us once more face to face with the problem of life itself. What force is it that leads men and animals to perpetuate their individuality by seeking food, and fleeing from or giving battle to enemies, or leads them to perpetuate their species by reproducing their kind? What is the universal fear of death but an instinctive tendency towards the perpetuation of both individual and species? We can find no cause for such actions and desires unless they are an imperfectly perceived connection with the undiscovered universe about us. May not some of the vibrations sent to us from the sun and other centres of radiant energy have a more profound influence upon us than we have knowledge of? The waves of light and heat are directly perceived by us—but what of the others? There is certainly an undiscovered universe. Whether it is identical with "that undiscovered country from whose bourn no traveller returns," time only can tell. Our mental and spiritual horizon is a very limited one. To a microbe a drop of jelly is a universe, and our own universe may prove in the future to be only an infinitesimal portion of an infinite whole. The little progress that we have made in comprehending the mechanism of the universe which our senses make known to us, only shows the vastness of that which lies beyond; and we must depend alone upon the great and universal law of progress and development to bring us to a complete understanding of the

conditions of our own existence, and a perfect comprehension of the great truth that the "Laws of Nature are the Thoughts of God."

IS THE SUN A MAGNET?

About 70 years ago, Oersted of Copenhagen found that when a galvanic battery was passed along a wire parallel to a magnetic needle, the latter tended to deflect so as to form right angles with the direction of the wire. This discovery formed the foundation of the art of telegraphy, and also the ground for a tenable theory in regard to the earth's magnetism. It was agreed that the solar rays falling upon the earth carry with them electric force which passes around the earth's surface in a direction parallel with the equator, and as our planet turns on its axis daily, that this is the force which causes the magnetic needle to point approximately north and south.

This idea has not been materially improved upon in the last half century, though in the course of that time several persons have laid claim to the discovery that the sun is a huge magnet, and found fault with the world for not hailing them as benefactors of the race. Scientific observations of the sun, says a scientific theorist, have, however, furnished a great deal of material for sustaining the hypothesis, and explaining some of the phenomena of changes otherwise inexplicable. It has been found that unusual disturbances on the solar surface, whether in the shape of big black spots which are depressions, or eruptive prominences, are followed by deflections of the needle, making what are known as magnetic storms, and that there is at least some connection between them and displays of the aurora borealis.

Some two years ago, Professor Bigelow of Washington undertook a series of investigations into the directions of the lines of force in the solar corona, that brilliant entourage of the sun which is witnessed only during a total solar eclipse. The results of his measurements and mathematical analysis, tend to prove that the lines referred to are identical in direction with those in the field of a terrestrial magnet, the rotation of the earth corresponding to the movement in the electricity-inducing dynamo. The parallel is also found to account closely for the well-known daily oscillation of the needle in the absence of magnetic storms, the effect varying at any particular spot on the surface as it approaches the sun during the morning hours, and then recedes from him in the afternoon. If the earth were stationary, the radiant force would be felt immediately, but owing to its rotation there is a lag of about 23 degrees of an arc or an hour and a half of time. On this point observation and the mathematics agree, and it is found that along the resulting curve in the lines of so'ar force, the light and heat pass outward from the sun while the magnetic force is directed inward.

An important theoretic deduction from these comparisons is that the sun acts magnetically upon the earth through the medium of interstellar ether, the earth reacts upon the moon in a similar manner, and by this will probably be explained certain movements of the lunar nodes which are not satisfactorily accounted for by the theory of gravitation, as well as part of the perihelion motion in the orbit of the planet Mercury. Still another curious point has been brought out, and this settled instead of being simply raised for solution. It is the rate of rotation of the sun near his poles, which has long been known to be slower than near the equator. The coronal pole being found to be about $4\frac{1}{2}$ degrees away from the poles of rotation, it has been found that the former rotates once in 27 days, 9 hours, 52 minutes, and 52 seconds.

The results of this study are accepted as valuable by several leading astronomers in America. An effort will be made to extend the observations, and in particular to examine the relations between magnetism and the weather, for which purpose improved magnetic charts will be supplied to navigators, and arrangements made for systematic observations at land observatories. If the theory be substantiated, it may result in a wide extension of human knowledge on the relation of worlds to each other, and in a better understanding of "the Newtonian Potential Function in the case of repulsion."

SOMETHING ABOUT THE HEART.

"Yes," said an eminent physician, "heart disease is common; it is, perhaps, much more frequent than is generally realised, if you take into consideration all the forms of heart disease. The heart, like other organs, is the seat of a large number of diseases, and the expression, 'heart disease' is as indefinite as the term skin disease; it may have a score of different meanings. I am inclined to believe that heart diseases are more common than they formerly were," he continued. "This is due to the great nervous and physical strains which attend our modern modes of living. But it is a great wonder that the heart is not more frequently the seat of disease than it is when we consider its delicate mechanism, its ceaseless labour, and, I might add, the abuse to which it is subjected. The heart is one of the most exquisitely constructed machines that can be conceived of. With its four chambers, its four sets of valves, and supplying its own motive power, it toils constantly, faithfully, for its three-score years and ten, without rest, without repair, responding to every demand, however unreasonable, until, finally exhausted by labour, or degenerated by disease, it is no longer capable of carrying on its function. It falters, then resumes its work, falters again as if to warn its host that he must be less exacting; again resumes and again falters, until, sooner or later, the last point of endurance is reached and it ceases to beat.

"Did you ever hear of a 'tired heart'? No one ever thinks that the heart may become fatigued. But it is true, and frequently the fact. The heart is just as liable to suffer from fatigue as is any other muscle in the body. I have never seen it mentioned in books, but the condition may be recognised almost as positively as any other abnormal state of the organ. A positive diagnosis cannot be made at once in most cases, because of the resemblance of the physical conditions to those present in dilation of the heart. But under rest and proper treatment the heart returns to its normal condition in a comparatively short time, which is almost an impossibility in the case of a dilated heart. Not a few cases of so-called nervous 'prostration' are nothing more than fatigue of the heart.

"Life would be prolonged by a little more attention to the heart; by paying a little respect to the most faithful servant we ever have. A great deal of good might be done, also, if parents would teach their children the danger of overtaxing the heart. They should teach them to stop and rest a few moments during their play when they are able to feel the violent throbbing of their hearts against the chest-wall."

TO INVENTORS.—Anyone having a good Invention can, on applying to the Editor, "Science Siftings," obtain the advice and assistance of a well-known Patent Expert, free of charge.

SOCIAL SCIENCE.

The Martial Spirit.

A distinguished modern essayist frankly confesses that "the fightingest parts" of the Bible are the ones that he reads with most interest and gratification. The same preference exists, undoubtedly, in the minds of a great many other people, if they cared to acknowledge it. This does not imply a want of proper moral discretion and appreciation, but only an inherent love of warlike literature, which is by no means a taste to be scorned and condemned. The most important events of sacred history are recorded in martial tones and serve to illustrate and enforce the bloody metaphysics of battle. We are given to understand that personal courage is a shining virtue, and that the worst of weakness is cowardice. Things come to pass because men of force make them possible. The heroes stand ready to assert themselves in answer to every demand of duty and honour. They are constantly looking for enterprises of bravery, of fortitude, of self-sacrifice. It is by their efforts that grave issues are decided and salutary examples provided for general encouragement and emulation. They do not stop to count the cost when vital interests need protection, but rush to the front with splendid contempt of danger, and stay there as long as their services are required.

It is this persistent manifestation of the fighting instinct that holds the first place in the story of the development of the race. The peacemakers do not exert any perceptible influence; their voices are hushed by "the thunder of the captains and the shouting." In every contingency of a serious and extraordinary nature, the soldier is depended upon to accomplish the desired result. The prophet is without credit unless he is also a military leader, having an army at his back, and knowing how to compel respect for his authority and his purposes. It rarely happens that gracious and conciliatory processes are successful, even where the occasions are of minor and transient importance. The philosophy of coercion prevails as a general thing, and little or no room is left for the application of temperate and persuasive facilities. All other considerations are subordinated to that of absolute and determined insistance upon a given claim or object. The test of physical strength, skill, and endurance supersedes argument and entreaty. There is never a resort to arbitration, and never a proposition of compromise. The cause that has not enough supporters to overcome opposing elements by taking up arms against them is doomed to failure, and not all the advantages of other kinds can avert the catastrophe.

Those portions of the Bible which deal with peaceful topics and proclaim sentiments of kindness and tenderness are of more value, we are taught to believe, than those which pertain to matters of combat and bloodshed; but the fact remains that the latter are more entertaining and impressive, and seem to have greater significance. That is to say, "the fightingest parts" appeal to the average reader in a sense that stirs his imagination and enlists his sympathy. He has that in his own nature which responds to tales of personal daring and triumph, The feelings by which those early warriors were animated are familiar to him, though he may never have seen a battle. They belong to him by inheritance, and qualify him for similar deeds of heroism whenever he is called upon to vindicate his manhood. He likes to read of warlike scenes and exploits because they have a distinct and practical meaning. He does not need to have them defined and interpreted. His heart beats in unison with them, and his intelligence fully comprehends them. If he had been there he would have acted the part of a soldier like the rest, on one side or the other, to win or lose. The grim realism of the Bible war stories is their principal charm in his estimation. They do not confuse him with technical details and theoretical inferences and suggestions, but give him the plain facts and nothing more. The facts may not be worth as much as some others from a spiritual point of view, but he can readily understand them, and that is decidedly in their favour.

This preference for the heroic is not confined to the Bible, but may be observed in all literary relations. The fame of the Iliad and the Odyssey is maintained not so much by their peaceful strength and beauty as by their clash and glitter of armed conflict. Homer is essentially a poet of military power and glory. His characters are distinguished for their fighting qualities, and for love of adventure and conquest. There is not a single non-combatant among them. The idea of compassing their ends by negotiating treaties of mutual concession does not occur to them; in all their controversies the martial spirit predominates to the exclusion of every sign of pacific thoughts or tendencies. They are never so well pleased as when fortune brings them opportunity for feats of courage, and sets spear-bearing squadrons in motion to adjust a dispute. The clouds of dust from warriors' tramping feet are always welcome, the sight of heroes "equipped all o'er in formidable brass" is a never-failing delight and inspiration. Life has interest to them only when it is expressed in tumult and triumph. They disdain the theory of pastoral safety and happiness, and pray to be delivered from "dull years of peace and propagation." There is nothing worth having, they feel, that can be purchased without the effusion of blood and the assertion of personal power and intrepidity.

It was a maxim of the Greeks that no more acceptable gifts could be offered in the temples of the gods than the trophies won from an enemy in battle. Such articles were held to be the best evidences of virtue because they were the best indications of courage and power. The gods were understood to rate men according to their ability as warriors and their success in the accumulation of spoils by personal peril and daring. "Of this military religion," says an eminent writer, "Christianity was at first the extreme negation." The introduction of arms within the church for any reason was strongly prohibited, and soldiers returning even from the most righteous wars were not admitted to communion until after a season of penance and purification. But this policy was gradually relaxed as time passed. The Christians were like other men in the respect that the martial spirit was a part of their natural endowment, and many of them enlisted in the army at the cost of excommunication. They were told by their spiritual teachers that all warfare was unlawful for those who had been converted, but that did not deter them from going where there was fighting to be done. In some translations of the Bible the four books of Kings were excepted for the purpose of repressing military enthusiasm, but it turned out to be a complete disappointment.

The military profession was finally brought into friendly connection with the religious system by the acceptance of the doctrine of Providential intervention in the affairs of temporal government. It came to be held that national catastrophes were due to moral errors and delinquencies, and that material prosperity was the reward of orthodox fidelity. A great battle, therefore, was invested with divine significance, and the hope of success was associated with the ministrations of the Church. Clovis was converted by the inference that the favour of God had given

him the victory in a critical contingency. Constantine saw the miraculous cross with the inscription announcing the Milvian triumph; and many other incidents occurred in the course of events to place the soldier upon a secure religious footing. Many bishops and abbots assumed the functions of military commanders, and the custom continued to as late a period as the battle of Agincourt. Thus the stigma attached to war by primitive Christianity was effaced through the operation of social and political influences, and the martial spirit secured recognition as one of the valid and useful forces of civilisation.

It only remained for Mohammedanism to appear in order to make the transition perfect, and to give Christianity over to permanent identification with the military theory of duty and progress. This new and powerful enemy created a panic and precipitated an emergency that could not be met with any other than warlike means. It challenged Christendom to a trial of strength that admitted of no parley and no evasion. There was only one course to be adopted. It was a question of fighting for cherished convictions, or cravenly surrendering them at the command of a hostile and relentless force. Then it was that Christianity quickly transformed itself into an agency of military energy, and prepared to defend its rights and interests with desperate sincerity and confident reliance upon its physical as well as spiritual sources. The holy zeal of religion was supplemented by the enthusiasm of martial service. From every pulpit was proclaimed the obligation to smite the unbeliever, and nothing more was heard of the policy of gentleness and forbearance. The courage that was evoked by this conflict became a species of fanaticism as the fighting went on, and led to excesses of punishment that should have been avoided; but it was splendid courage all the same and did not falter under any trial.

It was long ago pointed out by Dr. Johnson that "fighting is not absolutely forbidden in Scripture." The admonitions respecting the practice of kindness and forgiveness are not to be taken in a literal sense, he contended, but with a reasonable view of conditions and circumstances. "War civilises," he goes on to say, "and rearranges the population, distributing by ideas—the innovators on one side, the antiquaries on the other. When you replace the love of family or class by a principle, as freedom, the fire runs over the State line," burning with equal heat in all localities. The theory of the best philosophers is that war is one of the necessities of a developing civilisation, and that it is destined to disappear with the evolution of a higher state of general intelligence and morality. But they do not attempt to fix the date of this approaching millennium; and the signs of its coming are as yet quite dim and uncertain. There has never been a time when nations were more solicitous about the size and efficiency of their armies than they are at present; the aggregate expenditures for military purposes are heavier than they have ever been before under like conditions. This does not mean that a period of war is necessarily impending; but it does mean that the countries which are making these warlike preparations believe that there may be still a good deal of fighting to do on one account and another. The martial spirit has not been elimininated from human nature, they are well aware, and they do not propose to run any foolish risks of being caught at a disadvantage by an alert and powerful enemy.

Professor Helmholtz calculates that the light of the sun is 800,000 times more powerful than that of the moon.

SCIENCE AND ALCOHOLISM.

Dr. Keeley is an American physician who claims to have discovered a cure for "dipsomania." Whether this claim is justified or not, we are unable to say, but it is an unquestionable fact that papers of undoubted respectability and reliability in the United States are publishing accounts of his cures. How far, however, these may be due to abstention from alcohol—although the doctor does not enforce abstemiousness—and to what extent they are due to his subcutaneous injections (a preparation of gold) we are also not in a position to say.

Dr. Keeley's views on the disease are not without interest, although only partially novel. The most radical point is that in regard to the heredity of disease, which he contends protects people rather than destroys them, because it builds up a protection against disease which may amount to an immunity, and this is true of the hereditary drinker, he being the so-called temperance drinker. The "Christian" inherits a tolerance to the poison of alcohol from "a line of poison-pestered ancestry," so that he is able to consume, without trouble, a quantity that would make a drunkard out of an Indian, or Hottentot, or a Hindoo. Immunity from the action of poisons is only given by the action of poisons themselves. This may be obtained by inoculation, as for small-pox, or by long use, in which case it will become hereditary. The man who can inhale sewer gas containing tubercle bacilli and escape consumption is the one whose ancestors had so long been poisoned by the phthisis microbe that they had acquired immunity from its attacks. But if the man be no longer exposed to the infection, and his children be exempt from it, their descendants will in time begin to suffer from the disease. It is precisely so, Dr. Keeley claims, with alcohol and the germs of consumption. If neither of these two poisons were in the world the trouble of inebriety might be avoided, and the coercive teetotal advocate find his long-wished-for millennium. But the fact remains that if prohibition ever succeeds it will be after the banishment of the infections of disease and their poisons, and if we could prohibit disease infection the question of alcohol prohibition would take care of itself.

The diagnosis of consumption and chronic alcoholism, as hereditary diseases, is declared to be an error, though sanctioned by boards of health and life insurance companies. They ignore, Dr. Keely claims, the relation of a poison to the tissue cells, the latter varying by use to "a tolerance of the poison." It is this variation which, in either case, is transmitted by heredity, and it follows from this that the "inheritance is an immunity from the poison and not a transmission of disease." Atavism, or the tendency to return to a former type, is an important element of reform in cases of abuse of an organ or function, and in a physiological sense this largely depends upon the rapidity of action by the poison. It is in this relation to the human organism that alcohol stands out as far less dangerous than morphine. The variation of cells brought on by the use of the latter is so slow that it is next to impossible for an opium-eater to control his appetite for morphia, while the alcoholic poison acts so rapidly that the atavistic recovery of the cells only requires a few weeks' time, even without special treatment. Chloroform and ether are rapid in their action, and thus allow speedy recovery from their attacks. On the other hand, the ptomaines of disease (the poison made by microbes) act slowly. Two or more weeks are required in each of the acute diseases to establish a cell variation sufficient to make them tolerate the poison, and the cells may hold this

variation for many years, during which the person enjoys immunity from a return of the disease. This is true of small-pox, typhus, typhoid, consumption, diphtheria, cholera, and the yellow and other fevers, all of which are caused by poisons manufactured by microbes. All run their course till the cells have become accustomed to the influence. Then, if the organism has not been killed off, it recovers, because, when once it can resist the poison of a given disease, that disease must come to an end.

The change produced in the nerve tissues by alcohol is generally but an isomeric one; that is, an identity of elements and atomic proportions, the difference being only in the quantity combined in the molecule. It does not cause a degenerative change of tissue nor true inflammation, though it may have a pre-disposing influence in the etiology of some diseases. Hence, Dr. Keeley claims, there is no cure of alcoholism by following the course of Nature in bringing round the atavism of the cells after a debauch. This can best be done by gradual reduction of the supply, a sudden cutting off being not only cruel, but often dangerous. For both that and the opium habit it may be said that, when a man can live without distress for a week in the absence of the stimulus, his recovery from the disease is assured.

FORCING VEGETABLES BY ELECTRICITY.

Electricity is about to find a new employment in horticulture. Spring vegetables, we hear, are already being forced by its aid for market. There is no doubt that roses and other flowers can be made to bloom more plentifully and more profitably with its assistance. In short, the discovery affords promise of possibilities not yet estimated. It has been found that lettuce is particularly susceptible to the influence of the electric light, by means of which it can be grown for market in two-thirds the usual length of time. Other vegetables respond likewise in varying degrees. But everything depends upon the proper regulating of the light, and how to do this can only be learned by careful study of the results produced under all sorts of conditions. The effect of electricity being to hasten maturity, too much of it causes lettuce to run to seed before the edible leaves are formed.

It must not be imagined that electricity is employed for such purposes as a substitute for sunlight. It is merely used in a supplementary fashion. The greenhouse that has the sun in the daytime is illuminated at night with arc lights, towards which the plants incline their leaves and flowers, accepting quite innocently these artificial counterfeits of the orb of day. It was supposed hitherto that vegetables required intervals of darkness for their health and development, just as animals need sleep, but it has been shown that, supplied with electric rays, they will go on growing thriftily between sunset and daybreak; staying up all night seems to do them no harm so long as the dissipation is properly regulated.

The electric gardener employs opal globes to diminish the intensity of the light. When it is left bare and permitted to shed its unfiltered rays upon the plants the latter grow pale, run up quickly in sickly stalks and soon die. It remains to be discovered exactly how much electricity is beneficial and during precisely what period of the development of the vegetables it ought to be applied.

The influence of electricity upon the colour and productiveness of flowers has been shown to be extraordinary. Tulips exposed to its light have deeper and richer tints, flowering more freely and developing longer stems and bigger leaves. Fuchsias bloom earlier under like conditions. Petunias also bloom earlier and more profusely, growing taller and more slender. It is the same way with many other flowers. In fact, there is every reason for believing that the electric light will be very profitably used in future as an adjunct to forcing establishments for both flowers and garden vegetables.

THE EVOLUTION OF LEAVES.

As evolution is the eternal plan of unfolding, in the past, from nebulous matter to plant and animal life, it is absurd to suppose the same principle of progression will not continue to produce changes in the whole realm of being in all time to come. The investigator puts his finger on the long past geologic ages and says, "These forms are all that existed at this time": then he points out the advance of later times, and says, "This is evolution." But how this almost infinite change has been brought about, even the imagination constructs no definite plan. It is only by studying the evolution of the present that we can appreciate the changes of the past. To say that things are unchangeable is to ignore the truths of evolution. There is an ever on-flowing, rising tide, which bears all things on its bosom, unfolding higher conditions, and as a result, more perfect forms and qualities.

The leaves of plants offer to the evolutionist perhaps one of the best opportunities for studying the principle of progression actually at work; producing changes in the forms of leaves, their mode of individualisation, and numerical increase.

Attention was first attracted to the interesting study of variation in leaves by the *Ampelopsis quinquefolia*. As its name implies, it has five leaflets. Close observation, however, discerned leaves bearing seven leaflets. Sometimes the two lower leaflets were more or less notched or deeply lobed; continued search revealed various degrees of variation, from three to seven leaflets. These specimens were considered "abnormal," "freaks of nature," or "monstrosities" — interesting because unusual. It was observed that the *Ampelopsis* was not alone in its manifest variation from typical forms. On the contrary, plants quite commonly exhibit the same tendency. *Rubus villosus* is especially conspicuous in this respect. It has commonly from three to five leaflets, but very often the trifoliate leaves are notched and lobed as in the *Ampelopsis*.

Could it be that these different forms, these variations from the common type, were evidences of evolution in leaves? Can a series of leaves be found illustrating successive stages of variation? was the query which arose. The leaves of *Ampelopsis quinquefolia* were again examined, in all the neighbouring region. They had given rise to the query, and should, therefore, have the first opportunity of rendering a verdict. As the search continued, these odd forms, these "monstrosities," seemed to arrange themselves in regular order, like crystals marching into line. Instead of being "freaks of nature," they now stood like so many ballots in favour of evolution.

Starting with the ordinary leaf of *Ampelopsis quinquefolia*, numbering five leaves, the progressive stages, until it numbers seven, were found repeatedly, perhaps a hundred specimens, from a single vine of luxuriant growth. The first transition step apparently seemed to be but a slight enlargement or fulness on the lower or outer portion of the leaflets, near the base; this fulness increases until quite a conspicuous bulge is formed. A slight notch may be next observed, which deepens as the series progresses, until the lobe is cut entirely from the leaflet, becoming itself a new, perfectly-formed leaflet. A prominent vein is found extending from the base of the mid-rib, through the overgrown

or enlarged portion, to the extreme margin. This vein, later on in the series, forms the mid-rib of the added leaflet. The variation in the blackberry leaves emphasises this interpretation. The trifoliate leaves seem to be struggling towards the higher type represented by the five leaflets. This is seen so plainly and so commonly that it is the exception when a blackberry bush is found whose leaves do not illustrate various transition stages of division.

Potentilla Canadensis, common cinque-foil or five-finger, furnishes an extremely interesting illustration of various transition forms. It is an embryonic history of evolution in itself, which any one may read who observes it closely. Examples might be multiplied *ad libitum*, for plants everywhere, both in cultivation and wild, repeat the same story over and over again.

The mode of division in pinnate leaves differs from that just described in palmate leaves. In all pinnate leaves which have been observed, with one exception, the newly formed leaflets were given off from the terminal leaflet. The latter will often be found unsymmetrical or lopsided, occasioned by the extra fulness produced by this evolutionary tendency towards division. The vein which is destined to become the mid-rib of the future leaflet becomes prominent, and the outline of the unborn leaflet, as it were, may be plainly seen ere the division has proceeded beyond a slight notch. After a new leaflet has been given off, there seems to have been a portion of the parent leaflet cut away; and if the new leaflet be held close against this curved or cut portion, it will be found that it corresponds with the outline of the new leaflet. The opposite side of the parent leaflet will now be found to be the larger, and the burden of adding the next leaflet lies with it. After a leaflet has been given off from each side the terminal leaflet may again become symmetrical until a repetition of the process first described again takes place. *Tecoma radicans, Sambucus Canadensis, Ailanthus,* are familiar examples of this plan of division.

As stated above, there proved to be one exception to the general plan of division among pinnate leaves. This exception was found in the leaves of the rose. Search for transition stages was made again and again in vain, when one day the mystery was cleared away. At the base of the rose leaf two adnate stipules are found, and these stipules themselves may be called the little mother-leaves, for the leaflets of the rose appear to have been developed from the stipules. Specimens were found where the "promise and potency" of the future leaf yet existed in the stipules, awaiting, as it were, the magic touch of evolution. The upper part of the stipule becomes enlarged and leaflike, taking on more and more the shape and size of the normal leaflet, until a perfect one is formed. A graduated and progressive series was frequently found, showing various stages of transition, from the stipules alone to the mature leaf, consisting of seven or more leaflets. The new leaflets may be readily discerned before they are given off or separated from the stipules. The petiole lengthens as the leaflets are added, thus making room for the new-comers. If a rose-leaf is examined, the leaflets near the base will sometimes be found to be more or less alternate, but becoming opposite in the direction of the apex. This may be explained by the manner in which the leaflets are developed, viz., alternately.

The same laws of development are seen in the study of leaves as in the social world. Heredity gives the direction in the bud or germ, and the conditions or education unfolds it. If the season is favourable, the leaf takes a pre-impressed direction of growth, and surpasses its neighbours in assuming new forms, and the average is passed; while unfavourable conditions may produce a degradation, or appeal only to the lower states of development. It will be understood, therefore, that leaves do not undergo this evolutionary division during a single season. On the contrary, the principles of "natural selection" and "the survival of the fittest" have left their impress upon the animal and vegetable kingdom alike. Slowly but surely heredity transmits the gain through good conditions to succeeding generations. Through the long ages of the past, this process has been going on; each generation has passed on the improvements it received from its ancestry, and has added its own gain for the advance of its posterity. Each generation comes forth with renewed powers to unfold in some special direction, and we have endeavoured to show, in a few cases, the plan followed in the evolution of leaves.

THE EGGS OF EELS.

Nobody in this world knows whether eels lay eggs or not. If they do, man has never beheld them, and to get hold of any is quite out of the question. In case you want to establish eels in your water preserves, you can buy young ones by the pailful at a cheap rate, and they will grow big enough to eat or send to the market within three years.

It may fairly be said that the eel, as to its breeding, is the most mysterious animal in existence. Its method of propagation has puzzled science for centuries and has been a subject of more or less superstitious speculation among many peoples for thousands of years. The ancient Egyptians had their own theories respecting the matter. Some authorities have contended that eels grew up from horse hairs, which in some strange manner became vitalised. Others have held that they were generated spontaneously from slime, while others still have gravely advanced the belief that they came from the skins of old eels, or even from similar exuviæ of water snakes. Most popular among people who get their living from the water, however, is the theory that eels are the progeny of various other fishes. The Sardinian fishermen assert that they are produced by a certain kind of water beetle, which for this reason is called "mother of eels." The Greek poets, who fathered all children, otherwise unaccounted for, upon Jupiter, declared that this god was the progenitor of the eel.

All this mystery about the eel, as science has learned within the last few years, is due to the fact that it lays its eggs, or brings forth its young alive, in the sea, where no one has a chance to observe the process. Other fishes, like the shad, leave the ocean to spawn in fresh water streams, but this curious and slippery customer does precisely the reverse. The young eels, newly born or hatched, leave the salt water and make their way in armies up the rivers inland. Obstacles apparently insurmountable they use the utmost ingenuity in passing, even travelling considerable distances upon dry land in order to get around an obstruction. In the spring and summer any visitor to Niagara who descends beneath the great sheet of water at the foot of the falls will see literally hundreds of cart loads of small eels wriggling over the rocks and squirming in the whirlpools. Of course, it is impossible for them to get over the falls, and thus it happened that, although eels have always been plentiful in Lake Ontario, there were none in Lake Erie until they were planted in the latter body of water artificially.

Inasmuch as eels must go to the sea in order to propagate their species, they are found not to multiply at all when placed in ponds that are landlocked, although in such places they will grow rapidly and be healthy. It costs so little to purchase young ones by the quantity that this is no obstacle

to the usefulness of stocking inland waters with these fish. They have many very important advantages from the economic point of view, inasmuch as they will feed on anything, dead or alive, will thrive in water clear or muddy and at any temperature, and require no looking out for. However, in some rivers, where gull nets are used, eels are very undesirable. It is not unusual, upon hauling the nets in these streams, to find that the catch has been entirely eaten up by myraids of the squirming robbers, which have left little besides the heads and backbones.

In all probability eels lay eggs just as do all other fishes. The only difference is that they deposit them in the sea, instead of in fresh water. It is believed that the mother eel dies soon after she has spawned. For a couple of centuries past efforts have been made by eminent scientific men to discover the organs of generation in male and female eels. It is only possible now to discover the difference between the sexes by microscopic examination. About fifteen years ago the celebrated Dr. Virchow, of Berlin, published an advertisement for a female eel bearing eggs, offering a considerable prize for the specimen. Within a short time the advertisement was copied all over Europe, and the Herr Doctor received such enormous quantities of eels in packages that the affair became quite serious. So many thousand pounds of the very perishable article were consigned to him, that it was an important question how to get rid of the material, and one of the comic papers suggested that perhaps it would be well if he should make a regulation requiring all samples to be sent smoked.

THUNDERSTORMS TO ORDER.

Prof. Elihu Thomson, the American electrician, claims to have discovered the knack of making lightning. In a few days the scientific and electrical journals will publish full details, with accompanying figures, of Prof. Thomson's latest discovery. The invention is at present of more scientific than practical interest, although there will be plenty of practical uses for it eventually. The professor has succeeded by very simple means in securing extremely potential discharges. In an arc electric lamp the carbons are three-eighths of an inch apart, and in a search light a little further. The flame when the carbons are separated acts as a conductor. In Prof. Thomson's new machine, however, the distance is 8 inches, and no flame can leap so far. The result is the torrent of sparks is thrown off without interruption and with reports like the rattle of a Gatling gun or a case of fire crackers. The strength of the discharge appears to be limited only by the space of the machine. It has been suggested to the professor that he form a partnership with General Dyrenforth, the great rain-maker, and that the firm shall furnish thunderstorms to order. SCIENCE SIFTINGS is the first English newspaper to publish these interesting details.

SIFTINGS OF THE STUDY.

Photography in a Nutshell.

BY THE "KERNEL."

(London : Iliffe and Son.)

We have received a copy of the 5th edition of this book. The writer, who veils his identity under the quaint *nom de plume* of the "Kernel," has evidently a thorough grasp of the subject. The book is well up to date, and its articles on the treatment of special photographic subjects, such as "Moonlight Effects," "Lightning," "Interior Photography," etc., etc., are of particular and practical interest. The book is published at one shilling.

ANSWERS TO CORRESPONDENTS.

Questions to which answers are desired in this column must NOT *be marked "Science Queries and Answers."*

WM. EXTON.—Apply to the Maquay Electric Light Company, Frith-street, Soho, and to Cathcart, Peto, and Radford, 57b, Hatton-garden, E.C.

JOHN JONES.—See reply to W. Exton above.

DANIEL.—We firmly believe in the tonic and strengthening properties of the Turkish bath. The digestion depends greatly on the activity of the pores of the skin; these are most active when clean, and the Turkish bath is a great cleanser. Besides this, it braces up the muscles and enables the body to throw off a great deal of waste, thus cleansing the blood and driving off the ptomaines. The baths are good for all *healthy* constitutions, although we have even known men with heart disease take them constantly. Once a week is quite frequent enough. The best way to take a bath is to douche well with cold water on entering, drink a glass of water or non-alcoholic beverage; enter the hottest room you are accustomed to; remain there from 15 to 20 minutes; miss the medium room, and remain in the coolest room from 10 to 15 minutes. You should then perspire freely, and may be shampooed. Finish up with a cold plunge; dry roughly, and wrap yourself in a loosely woven Turkish towel. Remain in the cooling room for 40 minutes at least. Do not cover your head, and do not over fatigue yourself on leaving the bath. There is nothing startling or new in our paragraph, "What are you thinking about?" The body would collapse without rest; it is needless to add the same applies to the more delicate organisation of the mind. Insanity is to the mind what collapse is to the body. We believe everybody has these naps. Some may, however, not be conscious of them. When you are thinking "hard," you are most frequently unconscious of your physical movements, as the brain is devoting itself to the matter under consideration, and does not memorise independent movements.

A. GILCHRIST.—The force required to raise one pound of water 34 feet high is described as 34 foot lbs. As one horse-power is equivalent to 33,000 foot lbs., you can readily see that the power you speak of is approximately one-thousandth of a horse-power.

J. EASTWOOD.—The appliance you mention can be had from the Fry Manufacturing Company, of 5, Chandos-street, Strand. With the exception of the electric light, there is no better luminant than a good oxycalcium burner.

D. HERMAN.—We cannot afford space to describe the details of the automatic chess player. There is little of interest in these details, as they merely provided for the concealment of a living player within the box (apparently filled with mechanism), upon which the figure and the chess-board are mounted. The motions of the arm and hand of the "automaton" were controlled by well-known combinations of levers and strings. The course of the game was followed by the concealed player on an auxiliary chess-board. Every move was indicated by the motion of a light iron disc suspended from the under side of the chess-board. One such disc was hung beneath every square of the board; and the chess-men contained permanent steel magnets, by means of which the discs were of course attracted upwards.

YOUNG ASTRONOMER.—(1) You will find it in the constellation M V. The apparent right ascension and the apparent declination are, for 6th March, 14h. 21m. 50·8s., and S 11° 20′ 53·6″ respectively. (2) Yes. The sun is now moving towards a point in the constellation, Hercules having a right ascension of about 267° and a declination of about N 31°.

E. T. CARTER.—We regret to be unable to use your careful and accurate work. All answers are considered together, and there is no question of the "first to be suitable."

GEORGE LETHBRIDGE.—Thanks for your appreciative comments.

R. J. CROWLEY.—Thanks for your communication, which lends additional interest to the subject.

F. ELLINGWORTH.—Thanks for your letter. We had not forgotten the paragraph published on p. 149. The selected answer describes a method which is simpler, however, in principle, if not in practice.

C. PRICE.—Thanks for your interesting letter. Your speculations are ingenious, but we cannot accept them.

DURHAM.—Neuralgia is benefited by a mild electric current. One of the electrodes should be applied to the part affected and one to the nape of the neck.

W. J. T.—Lubricating oil should remain quite fluid after exposure to the air during a lengthy period. The most important point is that it should be perfectly free from the acids which are employed in its purification. A good test is to immerse a strip of bright copper in a bottle of the oil. Should acid be present in the oil, it will be found that after exposure in this way for a month or two, this strip will have turned green from the formation of a coating of verdigris.

SALE AND EXCHANGE COLUMN.

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Deposit System: To facilitate the transaction of sales between strangers, the purchase-money may be deposited with us. We will acknowledge the receipt of the deposit of both parties, and hold the money until we are satisfied that the goods have been returned or the purchase satisfactorily concluded. When remitting to the Seller, or returning the deposit (if no sale be effected) the following amounts, to cover expenses, will be deducted:—For amounts under 40s., 6d.; for amounts over 40s., 1s. In the event of articles sent on approval not being returned, or notice being given to us within 4 days, the sale will be considered effected, and the purchase-money forwarded to the Vendor.

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Remittances, etc.: All remittances must be made either by postal order or halfpenny stamps. Envelopes must be marked "Sale and Exchange," and addressed to the Manager, "Science Siftings," 78, Fleet Street, London, E.C.

Microscopic objects for mounting. 18 first-class miscellaneous, with full instructions for mounting. 9 double stained botanical sections, 1s. 1d. each series, post free. All microscopists should read "Practical Hints on Mounting," post free, 6 stamps. Mason, Manufacturing Optician, 69, Park-road, Clapham, S.W. 2

Student's microscope, by Beck, for sale, owing to loss of owner's eyesight. Cost £7 7s.; will sacrifice for £3. Three objectives and a quantity of slides and accessories. Address Student, c/o SCIENCE SIFTINGS, 78, Fleet-street, E.C.

Fifty thousand choice and interesting microscopic slides of every description; bargains; catalogues free. Suter, 5, Highweek-road, Tottenham, Middlesex.

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Electrical experimental outfit, enough for splendid entertainment, easily managed, cost £26—what offers in exchange? E., 21, Bristol-gardens, W.

American organ (handsome, large, £20), variety stops, swells, couplers, voxhumana; £8 8s. cash, or half exchange £10 10s. O., 21, Bristol-gardens, W.

Speaking machine, latest scientific wonder, speaks very distinctly, marvellous invention, perfect order, £2 2s., bargain. S.S., 21, Bristol-gardens, Maida-Vale.

Camera stand (folding cyclist's) for sale. Cost 25s.; price 10s.; good as new. Address Kingswood, Mortimer-crescent, St. John's Wood, N.W.

Two tusks of the narwhal (monodon monoceros), 5 ft. 8½ in., for curiosity collection or for ornamental purposes. Send offers to R. Levett, Swinton, Rotherham.

Wanted, horns wild animals, with skull or part of attached. J. Cooper, Killerby, Scarborough.

Photographer's complete outfit, Lancaster's ¼ plate camera and every requisite. Cash £3, or exchange to £5. Address 3, Kingsbury, Aylesbury.

Half plate camera, complete with accessories. Lens worth £4; sacrifice 40s. F. Bates, 69, Upper Kent-street, Leicester.

Tylar's hand camera, with finder and 6 single slides, new. Cost 23s. 6d.; will take 15s. Rothwell, 5, North Church-street, Fleetwood

Amateur's negatives, good specimens wanted, Isle of Man, and North Wales scenery, Llandudno district. Send list and price. Richard Waterhouse, Grove House, Stratford, Essex.

Wanted, hand camera, Kodak or Luzo preferred. Horwood, 32, Hill-street, Knightsbridge.

Powerful telescope, 30 in. long, 6 lens. Cash offers. Tarrant, Gorse-hill, Swindon.

Wanted, 2 or 3 kingfishers in the flesh, for stuffing, cheap for cash, or fresh skins of ditto. H. C. Hudson, 8, Withipoll-street, Ipswich.

Wanted, a microscope, portable preferred. State maker, size, and price, with full particulars. Hodgson, 52, Francis-road, Edgbaston.

Collection of 107 beautifully pressed and cardboard mounted New Zealand ferns, all named, £5, Pennell, 5, Gordon-street, W.C.

Quantity chemicals and good apparatus, cheap. Edwards, 5, Garlinge-road, Brondesbury, London.

Clarionet, B flat, nearly new, cost 70s.; will take 30s., or exchange with cash for strong, powerful microscope. Frank Bennett, 178, Bolton-road, Walkden, near Bolton.

Large poplar chrysalis, 1s. 6d. dozen. Exchange Cynthia, Pernyi. Herr White, 33, Shelgate-road, Clapham-common.

Wanted, Voightlander large field glasses. Kinahan, 48, Queen's Gate.

Two globes for sale, 4ft., high, 1 celestial and 1 terrestrial, on good mahogany stands. Would take 70s., or exchange any domestic useful article. M., Paxton House, High-road, Tottenham.

Spectroscopes.—Browning's student's, in polished cabinet, 2 large prisms and 1 small for showing two spectrums, 4 eyepieces, rack motion and vernier, with 1 dozen sealed tubes, in morocco case, cells, etc., and 1 Rainband spectroscope. Cost £22; sell for £12.

Ross's botanical and mineralogical microscope, with 5 objectives, in mahogany case, 90s., or exchange. E. W. Newton, Camborne.

Crouch's micro objectives, 3in., 2in., 1in., ½in., and 1/6in., cheap. 34, Great Elms-road, Bromley, Kent.

or exchange for whole plate camera, complete, with enlarging apparatus. W. Howarth, Burton-on-Trent.

Splendid pocket compass, by Tanger, Manchester. What offers? L. Openshaw, Poulton-le-Fylde.

Microscope, for student, new, 10s., or exchange. 2, Stockwell-mansions, Stockwell.

Microscopic slides on sale, from 3d. upwards. Holden, Hovland & Nether, Barnsley.

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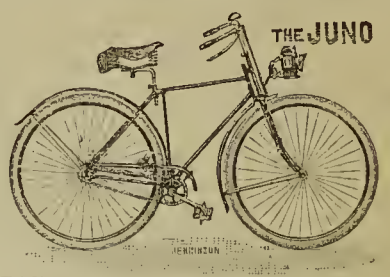

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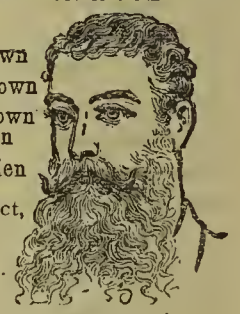

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CORRESPONDENTS *must write on one side of the paper only, and those who are brief and concise in their communications will receive the first attention. If no reply be given to offers respecting contributions, correspondents may take it for granted that the same are courteously declined.*

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LONDON: SATURDAY, MARCH 12, 1892.

SCIENCE NEWS AND NOTES.

"Unless above himself he can
Erect himself, how poor a thing is man!"—S. DANIEL.

The Proper Height of Rooms

intended for human habitation has been engaging some attention of late. It is commonly believed that height is of no significance as long as the ventilation is perfect. The error of this is pointed out by Dr. Buchanan and Mr. P. Gordon, medical officer and architect to the Local Government Board. They advise sanitary authorities to require a minimum height of nine feet for all rooms in which the ceiling is throughout parallel with the floor. The *Lancet* considers that such a minimum standard can hardly be regarded as excessive in the case of ordinary rooms. Indeed, such difficulty as arises in this matter is generally limited to rooms which are constructed either partly or wholly within the roof, and which are commonly called "attic rooms." When this class of room is considered it will at once strike an intelligent person that a standard which is deemed requisite in order to secure adequate breathing space on a first or second floor must be equally wanted on a third floor, even if the third floor room be an attic. As a matter of fact it is often more requisite in the attic floor than elsewhere, for servants and others, whose health requirements in this respect are, as a rule, less thought of than those of any other inmates of the house, are the persons generally relegated to the attic. One of the greatest evils which has to be contended with is the foolish habit of placing beds in the angle formed by the floor of the sloping roof. Therefore, our authorities stipulate for a minimum height of five feet in attics in addition to a mean height of not less than eight feet.

Low-Pitched Rooms

are comparatively more difficult to keep fresh—that is, to ventilate—than rooms of a greater height, and it is essentially in sleeping rooms that the determination of an adequate height is most important, more especially because the occupants are not able during sleep to vary the conditions of air movement through the room. The height of a sleeping room obviously needs to bear some relation to its floor space—that is to say, it should be determined with some reference to the number of beds that can conveniently be placed within it. Whether the number of persons occupying the beds shall have enough breathing space to keep them in health or not is the real question, and this must depend in an important degree upon the height of the room. In numberless cases the builders and the occupants, too, have regard only to floor area, and when this is excessive in relation to height, the natural tendency is to pack too many people in the breathing space available, and, whilst inconvenience on the floor level itself is avoided, overcrowding really results. But overcrowding of this sort is difficult to deal with as a statutory nuisance, and hence it needs to be prevented by having a reasonable standard minimum height of rooms. This standard, as we have indicated, has been fixed by the Local Government Board at eight feet over the total area of the room.

The "Lancet" Sanitary Commission

which is now inquiring into "Sanitation in the Shop," has evolved much that will be of interest to the general public. The water supply appears to be the chief grievance of shop assistants. One shop assistant complained that the only cistern available had not been cleaned for several years; the water, therefore, was too dirty to drink. Another assistant explained that the water in his shop was absolutely foul. It will be readily understood that, what with the flare of the gas, the dust, the constant talking to customers, considerable thirst must be experienced, especially in summer weather; and if there is not an abundant supply of pure water on the premises, the shop assistants are driven by the force of circumstances to the public-house, and soon find themselves on the high road leading to intemperance. The advocates of temperance would do well to look to this cause of inebriety. There is a philanthropic society which constructs troughs and supplies drinking water to dogs and horses in the street. If the temperance organisations could form a special service to see that a suitable supply of pure drinking water was provided for the human beings who spend the better part of their lives in shops, one of the causes of drunkenness would be removed.

The Most Interesting Point

to the public that has yet been brought to light by the Commission is the terrible insanitary condition of many shops. It appears that cellars used for the storage of provisions by grocers are, in many cases, pervaded by the

odour of drains; the provisions being actually stored round and about closets. This is particularly dangerous when such substances as butter are exposed to the escape of sewer air. At the branch establishment of one large provision store, the drains were the cause of such an intolerable nuisance, that a plumber was called in and an estimate made for repairs. When, however, the drains were dug up, it was found that the extent of the mischief was so great that it was impossible to put them in order for the sum proposed to be expended. The drains were consequently merely covered over again, and things allowed to go on much as they were before. This reveals a most dangerous state of affairs, and we trust that now it has been brought to light, the County Council will cease from troubling in directions where its attentions are impertinent to the good sense of Englishmen, and appoint proper inspectors to certify to the purity of the stores from whence the metropolis obtains its food supply. Such a scheme would undoubtedly save a mass of disease. We commend it to the notice of the Council.

Cremation

seems to be rapidly gaining ground in this country. This year's issue of the transactions of the Cremation Society records a narrative of comparative success with which cremationists have no great reason to be discontented. It is true that only the small number of ninety-nine bodies have been actually burnt in the society's furnace at Woking, but this total was in the year preceding represented by fifty-four, and in 1885 by only three. The principle of cremation, moreover, has gained the nearly unanimous approval expressed by a regular vote of the International Congress on Hygiene which met in London last August, while crematoria are either in contemplation or in course of erection in London (Ilford), Manchester, Liverpool, and Darlington. The *Lancet* mentions, as of special interest, the publication in this treatise of the latest contributions by Sir Henry Thompson and Mr. Seymour Haden to the literature of the subject. The opposite views of these gentlemen are well known, but they are here expressed in specially clear and practical terms. The former, in the course of an able argument, advocates cremation, especially in cases of death from zymotic disease, as being the only method preventive of post-mortem infection, which is at once easy and fully effective. His suggestion that a special official be appointed in each parish for the certification of deaths will be recognised as one of much utility. Finally, there is something to be said for his economic sense which grudges the use of cultivable land for the purpose of burial. Mr. Haden, on the other hand, is no less true to himself in asserting the full efficiency of the earth for the chemical and innocuous conversion of all dead animal matter freely committed to its action. This Sir H. Thompson does not deny, provided there be no adjacent and contaminable water-supply. A demand for legislative action to enforce the methods of sanitary burial, forms a natural part of the earth-to-earth system, and on this point we are entirely in accord with its well-known promoter. Until such action is assured we cannot, indeed, be said to have really tested the efficiency of our burial system; nor would we feel disposed, while it is in abeyance, to prefer, though we may agree to sanction, the much more rapid, though perhaps not otherwise more perfect, process of cremation.

Evolution has Resulted

in so many rudimentary alterations in the structure of man, that we are not surprised to hear that fresh changes are in store for us. The prehensile foot has gone, and now, according to Mr. R. Clement Lucas, lecturer on anatomy at Guy's Hospital, the little toe is fast disappearing, and the little finger is following in its wake. The little toe, Mr. Lucas tell us, is a useless appendage, almost as much out of date as the pineal gland, and owes it downward descent to generations of boot pressure. It has long since lost one of its extensor tendons, so that, if perchance a second one be now found, it is recorded by enthusiastic young anatomists as an abnormality.

The Future of the Human Foot

would appear to be a gradual suppression from without inwards of the toes, and a further strengthening of the great toe line on the inner side. That this is all that is required is abundantly proved by observing the thousands who, even at the present time, use only the great toe as a means of progression. Mr. Lucas was much interested some few years ago by observing the foot of one of the finest athletes of the day. He was an All-England three-quarter at football, a champion short or mid-distance runner, and the finest football kick of his day; yet he wore a boot so narrow that only the great toe could approach near to the end of it. All this brilliant performance was done by the great toe alone, and he showed on the running path and in the football field that swiftness, agility, and strength were, so far as the foot is concerned, centred in the line of the great toe. The enormous and increasing power of the great toe tendons is further illustrated by the feats of the ballet dancer, and a "première danseuse" would without doubt be soon hissed off the stage if she were seen to balance herself on any part of the foot other than the great toe. There are still some anatomists who affect to be enamoured of the beauties of the savage foot. It is a long-toed, long-heeled, low-arched splay foot, useful no doubt to prevent the limb it supports from sinking too deeply in the native sands, or to aid the hands in upward-tree progression, but as distinct from the civlised foot as the huge hoof of the Shire horse is from that of the thoroughbred.

The Suppression of the Little Finger

will, however, more quickly appeal to human emotions than the loss of the little toe. The little toe has been charged with being of no practical use, "except to act as basis for a corn." The little finger is a thing of beauty to most people. It would seem also that Nature, having arrived at a tendency to suppression in a particular individual—of which the earliest indication may be a shortened or bent finger—in some of his descendants may sweep away wholesale the fingers of a hand. There is an obvious reason, Mr. Lucas thinks, why there should be less opportunity of establishing heredity in cases of suppression than in superabundance, because in the former the loss is apparent, and is classed by the general public as a deformity to be avoided; whereas supernumerary digits are usually removed by surgeons during infancy, and thus the tendency is concealed. Such suppression as occurs is supposed to arise from disuse through generations upon generations, or through ages upon ages, and that which Mr. Lucas maintains can be shown to be taking place in the case of the little toe, is so gradual and so general that any idea of deformity is completely enshrouded by time. It is only when we observe an abrupt suppression in development that we regard the result in the light of deformity. When such tendency exists, no doubt in-breeding would increase and perpetuate the defect; and it is not improbable that in families, where several well-marked instances occur, there may have been an accidental union in the parents of two individuals, each with a slight deviation from normal

in the direction of the result produced. Hence the importance of observing minor defects which, increasing by generation, may be pregnant with graver deformities in the unborn future.

The Best Test for Death

has frequently been discussed in our columns. Until now the palm has been accorded to the method that gained the prize at a recent French competition. If the hand of the body, when held up to the light, did not reveal a pink transparency between the fingers, death was said to have supervened. We are now, however, pleased to be able to record a much surer method, the result of an experiment, the consequence of which was the revival from apparent death of a St. Petersburg lady. She had been suffering from a violent nervous attack, sank into a state of syncope, and after a time ceased, as it seemed, to breathe. The doctor who was attending her certified that death had resulted from paralysis of the heart. For some reason, which is not explained, another medical man, Dr. Loukhmanow, saw the body, and having been informed that the lady had suffered from attacks of hysteria and catalepsy, thought it worth while to make a thorough examination. After trying various other means he applied the microphone to the region of the heart, and was enabled by this instrument to hear a faint beating, which proved that life was not extinct. Everything was done to resuscitate the patient, who, shortly afterwards, recovered consciousness. This inaugurates a new use for the microphone, and its application in this direction to the detection of sounds too feeble for the unaided human ear, will cause it to rank as one of the most valued servants of man.

Who has the Right to be Styled "Doctor"?

is the apparently simple question that has of late been agitating the minds of medical men. The usual answer to the question is that only a man who has graduated in a University, and has thereat been the recipient of a doctor's degree, has the legal right so to style himself. So far, the case seems clear enough; but there are medical men who do not possess the degree of doctor in medicine, and who, being Licentiates or Fellows of the Royal Colleges of Physicians or Surgeons, are believed to be able to rejoice each in the designation of plain "Mr." Almost every surgeon, for instance, whether possessing the doctor's degree or not, styles himself "Mr." the designation of "Dr." being reserved, apparently, for the physician. Yet it is difficult to account for the heart-burning over this matter of style, which seems to have become chronic, judging from correspondence in the medical journals. Why should not every qualified medical man, licentiate or otherwise, call himself "Doctor" if he pleases? "Because," says the possessors of the "M.D." degree, "we who have graduated as doctors in medicine have alone a legal (?) right to what is recognised as a superior title." One might be inclined to retort, In what way "superior"? Is a man who has graduated as "M.D." necessarily a superior person to the man who is a fellow of a college of surgeons, or to one who is a fellow or licentiate of a college of physicians? Dr. Andrew Wilson thinks an affirmative reply to this question will be difficult to maintain. Besides, there are bachelors in medicine, who boldly style themselves "Doctors" (*vide* their door-plates), when they have no more title to the designation than their theoretical inferiors of the colleges. The real fact is that, if the doctors only knew it, the public are apt to smile at medical squabbles in this matter of style. Who is going to discard their trusted and faithful medical adviser because he is plain "Mr." to the faculty, but "Doctor" to everybody else. When, Dr. Wilson asks, will ever medical men learn the truth that it is not the degree which makes the doctor or the man, but that it is the man who alone can ennoble and render famous any degree?

The Therapeutic and Physiological Effects of Ozone

have just formed the subject of researches by two French scientists. A curious experiment was made. An ozone generator was used, which consisted of a closed glass tube containing rarefied air (which acts as one of the poles), surrounded by a tube, on the inner surface of which was a metallic thread. The space between the tubes was 3—4 mm., and across this space the spark which produces the ozone was passed. Ten of these tubes were used, each being about 800 mm. long; they were placed in a laboratory of 300 cubic metres air space, and were actuated by an alternating current from a Gramme machine with a potential of 7,000 volts. The tubes having been placed vertically, the slight rise of temperature resulting from the discharge caused a continuous upward current of ozonised air which mixed with the unaltered air of the laboratory. After about a quarter of hour the laboratory was filled with a bluish cloud of aluminium oxide, and direct experiment showed that the electric discharge caused the volatilisation of weighable quantities of aluminium from the electrodes.

An Unexplained Phenomenon

created much interest at a recent meeting of the Iron and Steel Trust. A member showed that the interior of a piece of mild steel may be raised to the fusing point while the outside remains solid, just as if one were to try to melt an iron tube, closed up at each end and filled with some metal of a lower melting point than iron, in which case the heat would penetrate through the iron and liquefy the interior long before the tube itself would be affected. The member showed some curious specimens of shells of crop ends and other pieces of scrap steel, which had retained their exterior form, although about two-thirds of the original mass had melted out. No explanation of the phenomenon was offered.

A Standard Time

is the one subject on which the whole of the human race is agreed as being desirable for the universal weal. The discussion has met with some measure of success. In Belgium, from May 1, 1892, Greenwich time will be substituted for that of Brussels, and on April 1, 1892, it has been arranged that on all railways eastward from the French and Belgian frontiers into Austria-Hungary only one time is to be used. Some fifteen years ago the Canadian Institute took up the question of time reckoning, and was followed by the American Meteorological Society. The latter, rising above national jealousies, and in the most praiseworthy manner, decided at the Conference of Washington in 1884 to have their time reckoning based on the meridian most likely to suit the convenience of the greatest number. This generous resolve was followed by all the countries taking part in the meeting except France and Brazil and the insignificant Republic of San Domingo. France still refuses to recognise—and prejudice on her part has delayed the introduction of—Greenwich as the universal meridian, and it is this jealousy that bars the way. The French want Paris and Paris only as the universal meridian, though last year it was suggested, *Home News* tells us, that Jerusalem of all places in the world should be taken. In the meantime the nations are impatient and will not wait, and are unanimous as to adopting the lines indicated by the Washington Conference.

GLEANINGS OF THE GLOBE.

THE utilisation of the power produced by the ebb and flow of the tides has been made in Havre to work turbine wheels, which generate the power necessary to run the dynamos which furnish Paris with the electric light.

IT is considered by competent authorities that the application of the electric light would tend to increase the amount of yeast formed during the concluding processes of fermentation in the brewery.

ACCORDING to the Photographic Society of India, photography is rapidly becoming more popular among Anglo-Indians. In January, 1891, there were 277 members on the Society's books; now there are over 310.

ANOTHER parasite has been discovered. It is said to infect paper money and is found nowhere else. It is invisible to the unassisted eye, does not attach itself to persons, but multiplies at a rapid rate. We have heard of the paper money parasite before.

IT has been shown that the incandescent electric light does not "smoke" the ceiling, as has been claimed, but that the smoky effect is due to dust. The heated lamp causes a current of heated air to rise, and the consequence is there is more dust deposited above the lamp than anywhere else.

THE parent cuckoo not only lays her eggs in the nest of another bird to save the labour of hatching, but when the young bird is hatched, it ejects any other callow offspring that its foster-parent may have hatched, in order that there shall be no dearth of food for itself. This is an ample illustration of the survival of the fittest.

CYCLONES of grand dimensions are frequently generated in the zones where the trade wind of the opposite hemisphere penetrates. They are caused by an augmentation or swelling in volume of air, proceeding from the opposite hemisphere, attending unequal distribution of the normal limits of the atmospheric circulation, and determined by the retardation which the trade wind or monsoon meets with in following the sun's movements.

A SINGULAR phenomenon of the Bay of Callas, called the "Painter," is observed only during the summer months, and consists of emanations of sulphuretted hydrogen gas, with a reddish discolouration of the water. The gas comes from black mud on the bottom, and the colour is due to infusoria brought in from the open sea. The "Painter" is known in a few other places, but seems to occur only where a river flows into a bay closed by a current flowing past its entrance.

THE sudden disappearance of oysters from places where they were formerly numerous may be explained by a recent remarkable visitation of the harbour of Sydney, N.S.W. The water, in places, suddenly assumed the colour of blood. This proved to be due to the invasion or rapid development of a microscopic parasite, which in a few days destroyed half of the animals near the land, and seriously injured the oyster beds.

THE unpleasant suggestion has been made by a Vienna doctor that the tubercle bacilli may be in the dust of our streets. He bought some grapes at a stall, and after rinsing the dust from them in pure spring water, he found the water very dirty. As an experiment, he injected some of this water into three guinea-pigs. One died in two days of peritonitis; the other two also died, but after a lapse of over a month. On examination the bodies showed pronounced tuberculosis originating in the site of inoculation.

THE colour of the sky in England has been found by Lord Rayleigh to be more saturated (that is, free from alteration by reflected white light) than that observed at Potsdam by Professor Vogel, and M. Crowe finds that, at Montpellier, in the January of last year, the saturation was greater than that of either English or German skies. It is obvious that the quality of saturation must play an important part in successful delineation of white cloud against blue sky by photography.

IT is said that a strict Jew will not kindle a fire on the Sabbath, although sometimes he has no objection to allow a Christian to do it for him. But may he turn on an incandescent lamp? This puzzling question has been put to Professor Wm. Crookes, who, we are told, after pointing out that the sacredness of fire and flame in the old Eastern religions was always intimately connected with combustion, has decided that the glow of the electric lamp does not come within this description.

A RARE electrical phenomenon created considerable excitement in the Quartier du Bourg, in Fribourg, one day last month. A sheet of flame, about one metre high, and of greenish-violet hue, rose above the head of the bronze statue of P. Girard, and lit up the whole square to the clearness of daylight. The electric wires, loaded with snow and swayed by the wind, which are stretched above the monument caused this discharge. In the Peier brewery, which is lit by current conveyed by these wires, this impromptu out-of-door illumination caused an almost entire extinction of the electric lamps.

PROF. KAUFMAN, of the Veterinary College at Atfort, has discovered that chromic acid, used hypodermatically, will destroy the poison of snakes and other venomous reptiles. The treatment consists in the cautious employment of a one per cent. solution by the ordinary hypodermatic syringe; and, at the same time, where the bite happens to be at one of the extremities, the limb should be ligatured, in order that the medicament may have an opportunity of being diffused throughout the tissues.

THE "Bad Lands" of Dakota, U.S.A., are good for nothing on the face of the earth but fossils. It is a remarkable fact that every portion of the hills there, however, are absolutely filled with evidences of animal life. Fossil insects, fishes, birds, the bones of the elephant, the mastodon, of the lion, the tiger, and of scores, if not hundreds, of extinct animals and species, are to be found in the same hillside. In one declivity, where the rain had washed away the underlying earth and a heavy slide had occurred, were found, in a space not exceeding 30 feet square, the fossil remains of seven distinct species of mammals, of seventeen species of fish and of five varieties of birds, while the shellfish and insect remains were too numerous to count. By what great natural convulsion this district was made the graveyard of millions of animals it is impossible to say, but nothing short of a tremendous and widely extended calamity could, in one comparatively small tract, have destroyed as many animals as must have perished there.

SCIENCE QUERIES AND ANSWERS.

A prize of two shillings and sixpence will be awarded for every interesting question asked by our readers and published in this column, and five shillings will be given for every answer published. In all cases when a similar question or reply is sent in by two or more correspondents, the award will be given to the one whose letter is first opened, provided the subject is properly treated. Questions asked by correspondents and not replied to by our readers, may, if of sufficient interest, be dealt with Editorially.

Rules for Competitors.—(1) Only one question may be sent each week, but any number may be answered. (2) Write on one side of the paper only. (3) Envelopes must be marked "Science Queries and Answers," and must arrive not later than the Monday following date of publication.

The following are Answers to Queries published in No. 19.

37.—What difference is there between the muscular fibres in man and woman that confers upon the former greater strength?

The elementary fibres of men's muscles are, on an average, $\frac{1}{352}$ in. diameter; those of women only $\frac{1}{454}$ in. It will be understood that, in consequence of their mutual pressure, these fibres are not circular in cross section, but polygonal. The blood vessels supplying these fibres are interposed at the angles of the polygons, whence it follows that those muscles are best supplied with blood vessels in which the size of individual fibres is the smallest. The consequence is that while men's muscles are stronger, by reason of their bulk, those of women are more fitted to withstand continuous exertion. In beasts of burden the average diameter of muscle fibres is $\frac{1}{561}$ inch—still smaller than in woman. But here I need not say that it is far from my intention to imply that our better-halves were designed in any way as "beasts of burden." Birds which are so admirably fitted for continuous, though slight, fatigue, have muscle fibres only about $\frac{1}{800}$ in. diameter. Let any man who doubts this statement, as to the greater power of endurance of the gentle sex, just put it to the test by carrying a child upon his arm, for the same length of time as a woman can carry it with ease. He will find himself considerably fatigued, and willing, I daresay, to admit that the long distance bicycle record ought to be broken by a woman.

38.—Are rifled guns necessarily more accurate than smooth-bores?

Yes, for the spinning motion of a rifle bullet, as of a spirally-feathered arrow, confers on it a powerful resistance to any change in the direction of its axis of rotation. This resistance is analogous to that which may be observed in the case of a spinning top or gyrostat. Without it, the direction taken by the bullet is found to be greatly influenced by any small irregularity in the muzzle of the gun, or by want of symmetry in the projectile itself, as when the centre of figure does not coincide with the centre of gravity. Smooth, oval bore rifling has been tried; also bullets so shaped as to receive a rotary motion in consequence of their rapid passage through the air, but, for different reasons, these attempts to replace the ordinary rifled barrel have not proved, and cannot prove, satisfactory.

39.—State, broadly but concisely, some distinctive feature by which animal life may be defined and recognised.

A living animal is the seat of continuous transformations of potential into kinetic energy. These transformations are usually referable to the oxidation, by respired air, of organic matter, derived primarily from the vegetable kingdom. They are clearly distinguished from the somewhat similar transformations which have been effected by assemblages of lifeless matter, inasmuch as the machinery of Nature will utilise no other fuel than such as is adapted, not only to oxidation, but primarily to the formation of animal tissue. "Combustion," as it were, takes place throughout each member of the animal economy; and as in no conceivable assemblage of dead matter, it is the wastage of every minute component part that maintains the energy and integrity of the whole.

40.—What is the source and value of the anæsthetic cocaine?

It is derived from the coca plant, the leaves of which are used by the Peruvians and Bolivians as a stimulant to the nervous system. This plant grows best in the Andes, at an elevation of between 2,000 and 5,000 feet, where the temperature seldom falls below 65° F. The peculiarity of the soil is that it is very well drained, and rich in humus. After drying, the leaves of the coca plant possess a fine green colour, and an agreeable odour resembling that of hay and chocolate combined. They contain a little over half a per cent. of cocaine, and are valued at upwards of 6d. per pound. A crude alkaloid extracted from the leaves and containing about 70 per cent. of pure crystallisable cocaine, is now selling at 15s. per ounce.

41.—Is consumption transmissible hereditarily; and is it infectious?

Yes. It is undeniable that tubercular disease is transmissible by heredity. The bacilli, which are the authors of all such diseases, have been found, in the case of rabbits, within the ovum. They have been observed in the lungs of an unborn calf, and have even been seen mingled with active spermatozoa. Furthermore, it is probable that a condition of the tissues favourable to the growth and development of the tubercle-bacillus may be, and often is, inherited. By reliable authorities it is stated that about 50 per cent. of the deaths from phthisis are due to hereditary causes of one kind or another. Of the infectious character of the disease there cannot be the slightest doubt. In cases of advanced phthisis, tubercle-bacilli have been isolated from the breath. They are found, also, in the perspiration; and bedclothes or wearing apparel may, therefore, be rendered a media of contagion, and may retain their fatal efficacy during many months.

42.—State the distinguishing characteristics of mechanical mixture and chemical combination.

Mechanical mixtures exhibit properties regularly graduated according to the relative quantities of the constituents, and these properties are intermediate between those of the constituent particles. It may be added that in mechanical mixtures, and in these only, can the component particles be readily separated from one another by mechanical means. In compounds, on the other hand, the proportions of the constituents admit of no variation whatever, and the bonds of chemical attraction, by which they are bound to one another, can only be loosened by the application of chemical force. Qualities, differing from those of either constitutent, are possessed by the chemical combination, and when several compounds are produced by the union of the same chemical elements in several different proportions, each exhibits distinct and sharply defined characteristics, that inhere in the minutest particles into which the compound substance can be divided.

QUERIES.

Replies to the following Queries must reach the Offic by Monday at latest; and those selected will be published in the issue after next.

49.—What is the minimum food consumption on which human beings can subsist?

50.—What are the effects of alcohol upon the human frame?

51.—In what position would a terrestrial body be most powerfully acted on by gravitational force?

52.—When was magnetism first used for the extraction of particles of steel and iron from the eye? And by what means is this agency now applied to that purpose?

53.—What natural cause regulates the very different consumption of salt in different communities?

54.—In what way is the density of the earth determined as against that of a mountain?

ELECTRICAL AND CHEMICAL ENERGY.

Of the various transmutations of energy, that of *chemical separation* into *electricity in motion* in the voltaic battery, and of the latter into the former in the case of decomposition by a battery, are among the most interesting. In the first case, the sources of electrical excitement are the points of contact, say the zinc and platinum when we have electrical separation produced; but this would not produce a current *per se*, for an electric current implies very considerable energy and must be fed by something. The supply is kept up and really produced by the oxidation and dissolution of the zinc, and the chemical separation of the metallic zinc is transmuted into the energy of the current. In the second case the energy of electricity in motion is transmuted into that of chemical separation when a current of electricity is made to decompose a compound substance; as, for example, when a battery is used to decompose water. Heat apparently disappears during this operation, but it is given back when the mixed gases—oxygen and hydrogen, which result from the decomposition—are exploded in a eudiometer.

Recently this interesting subject has been placed under investigation by E. Levay; he specially gave his attention to the study of the relation between the electrical and chemical energy in galvanic cells, and the object of his experiments was to determine for certain of these cells the heat generated chemically and the heat equivalent of the current, so that he might be able to obtain an exact measure of the difference between the two.

The heat evolved in the cell was determined calorimetrically, and that of the circuit in like manner by means of a silver voltameter placed within the calorimeter along with the cell.

Two cells were examined, namely, the Daniell and the De la Rue, and three calorimetric determinations were made with each cell. In the case of the Daniell cell, the heat equivalent of the current appears to be greater than that which is generated chemically, so that the net result is that the cell works with an absorption of heat. The reverse is true in the case of the De la Rue cell; but in this case Levay observed that the relative amount of electrical energy increases with the concentration of the solution in the cell. These results show a close agreement with those obtained formerly by Jahn. The original paper appeared in the *Ann. Chem. Phys.* [2], xlvii. 103.

March 19th will prove an interesting date to astronomers. On that day the earth will be in the plane of Saturn, at the period of time when that portion of his ring which appears to be the most dense will present itself to us. An occasion will thus be afforded of observing one of the most remarkable of celestial objects, on the constitution of which divers and contradictory theories have been broached.

A CANNIBAL CAROUSE.

Herr B. Linnemann, an engineer representing the German Government, returned recently after three years' explorations among the cannibals of New Guinea.

Herr Linnemann visited the interior of both New Guinea, so called, and New Britain, on exploring expeditions, and roughly surveyed the wilderness of New Guinea back from the sea coast. He had many thrilling experiences among the savages, and had to be on his guard very warily on many occasions because of the danger that surrounded him.

No European had ever before invaded these forests, says Herr Linnemann. My feet pressed the earth remote from the explorations of the Caucasian race. It was the native home of the savages. Many of them had never been near the coast, and had scarcely any knowledge of it except by hearsay, consequently their knowledge was very vague.

I was interested beyond measure in their strange customs. They were naked. Not a thread of any kind do these natives wear. Men and women alike appear as on the day of their birth. They are large, stalwart savages, strongly built, and with crisp black hair and eyes. Their skin is scarcely so dark as that of the Samoans or Hawaiians. For, indeed, they are of another race. The Samoans and Hawaiians are Polynesians, but these are Papuans. Many of them are six feet high, but most of them are about five feet eight or five feet ten inches.

The women are also of good size, well developed, and often handsome. The women, however, have no influence over the men. A white man can buy a woman for enough of the native money to make, say, from £2 to £5. A very pretty woman can be got for that, and often for less. One who is not very pretty can be got for half that, and an ugly one for a good deal less.

When a man has bought a woman she is his absolutely, and if she violates her faith with him she is killed and eaten. They were very strict about that. They will not kill and eat her at or near our trading posts, for years ago we began inflicting severe punishment on them for cannibalism, but they will lure her away to the woods and then cut off her head and cook her up. We never hear of such women again.

It is only for such things that a tribe will so dispose of one of its members, but tribe preys upon tribe, steals men and women away from each other and eats them. The German Government and the New Guinea Company do all possible to prevent this, but they can not stop it. The savage accomplishes it in the woods remote from the posts, and about all we know is that the natives are disappearing. No member of a tribe will come down to the coast and tell of it.

When I went into the interior, however, the natives were bold, and on one occasion I came upon a party of natives who had cooked the body of a young woman. The fires were burning among the palms, and a gloomy light was thrown out. The dead body had been cut in pieces, and the parts were cooked through and through. It was a fearful sight, and as the natives stood about, each eating his piece of human flesh, I thought no living person had seen or could see a more horrible thing.

One of the savages advanced toward me with a fleshy piece in his hand, and as he came closer I saw that it was the woman's arm.

The body, after it had been cut to pieces, was cooked with leaves of the tarro and beal-nut tree. This gives the flesh a spicy flavour. I have eaten the spice leaves and they taste very well, the flavour being pleasant.

CREATION AND CHAOS.

A new theory of the universe has been formulated by an ingenious correspondent of ours; and while the theory is certainly not one to which unconditional assent could be given, it is, in our opinion, of sufficient interest to be briefly noticed. Our correspondent supposes the material universe, which, in a certain sense, may be designated as "the universal ether," to fill a sphere that is, relatively to our ideas of capacity, almost infinite, while yet, perhaps, not wholly removed from within the bounds of approximate representation by figures. The surface of the sphere is the boundary of the ether, but as to its precise nature no definite conjecture is hazarded. It is well known that, in close association with minute particles of matter, there is, virtually at least, a state of condensation of the etherial medium. And may we not also suppose that there is, upon an infinitely larger scale, some tendency to condensation of the ether about—that is to say in the field occupied by—the great spheres of which the material universe is constituted. Whether or not, the ether has weight, and therefore, on the assumption propounded, we may imagine that it has a "centre of gravity" at which our material system is situated, or about which it may be swinging or rotating. We suppose, then, that the universal sphere or atmosphere of ether is bounded by empty space, and that, as the ether particles are undoubtedly knitted together in some way, the spherical surface is capable of resisting finite forces tending to bulge it outwards. Now accepting the commonly-received theories, we will follow out the great cycle of changes from the time when our material universe consisted of an atmosphere of enormously heated helium, situated at the centre of the etheric sphere. Since then enormous quantities of heat have been radiated from our system outwards. But is this heat never to return? One might suppose at first sight that, in the act of reflecting such a volume of energy, the "ether surface" would be subjected to a very great amount of strain. This supposition would not, however, be at all correct. The earth, as everyone knows, reflects a large proportion of the solar rays, and yet the reactionary pressure, due to this reflection, has been estimated as within that due to the weight of a threepenny piece, distributed over each acre of effective surface. From this fact we may reasonably conclude that upon the enormously extended "ether surface" presupposed, the reaction due even to the reflection of energy so great as that which is in question might be, per unit of area, something indefinitely small. We may conclude, then, that the great spherical waves of energy emitted by the intensely heated mass of matter, travelled outwards towards the confines of the ether with the speed of light;—that when they reached its boundary, if, indeed, they have already reached it, there was reflection, with formation of enormously great systems of stationary and otherwise interfering waves, and that the return journey was commenced, and is continued with, undiminished speed. At this immense velocity, of 86,000 miles per second, these waves may be returning. They may be, probably they are, still separated from us by millions of decades of travel. But, on the other hand, we "know not the day nor the hour" in which their withering breath may steal upon us. Then "the elements will melt with fervent heat" and matter will return into its primitive condition. This discloses a system of the universe in which three things are postulated—the mass of matter—the atmosphere of ether—and a violent and slightly irregular disturbance, propagated inwards from the etherial surface. Granted these conditions, and all that follows does so by virtue of the "laws of nature," with which our daily experience renders us familiar. We may predict a gradual shrinkage and death of the solar system—a condition in which inert matter, almost "without form and void," will occupy the centre of the etherial sphere. But, if the ideas suggested be acceptable, we may carry the mind's eye still further forward, to the return even of those slow and lengthy waves of radiant heat, by which all known varieties of energy are now being dissipated into space. We may anticipate, as has been already indicated, the return with undiminished intensity of far more highly energetic heat waves. But whether the waves be long or short, no doubt can be admitted that, by means of their mutual interference and reinforcement at a focal point in which, as we suppose, the dead worlds lie, a temperature will be produced, fully competent, according to the nebular hypothesis, to effect the production of "a new heaven and a new earth."

A NEW POWER WANTED.

A correspondent is not satisfied with steam or the more recently adopted electric power, and wants somebody to invent something better. It will be done, he thinks. The atmosphere is full of electricity, and, when overcharged, relieves itself in thunderstorms, and as these storms occur in hot weather, it would go far to prove that heat is at the bottom of it, and, if such be the case, he asks, why could we not devise some plan to produce and concentrate it at once by the use of gas or coal oil? That lightning has an affinity for coal oil is shown by the number of times large tanks are destroyed by it. The man who can devise some means for operating a motor cheaply that can be used in both city and country, can take his ease for the balance of his life. It would be well if some genius would turn his attention to something outside of the beaten paths of steam and electricity, and see if, in looking for one object, he is not overlooking another equally good.

Since air is the motive power that keeps so many animate machines in motion, why should it not be brought in use to move inanimate ones? We know that air presses nearly a ton's weight upon every foot of exposed surface. Now, if we could, by some means, mechanical or otherwise, exhaust that air from one end of a cylinder having a square foot of exposure, we should have a ton's pressure upon anything filling the cylinder, which would force it to the end, and if this could be repeated at the other end, we should have the action of the piston of the steam engine reproduced.

Since the first steam engine owed all its efficacy to atmospheric pressure, would it not be well to see if the same means cannot be devised to utilise air, not in a compressed form, but by exhaustion at one end of the cylinder or in some other manner? If this could be done, either mechanically or otherwise, it would displace all other modes of transmitting power and could be used as well on the desert as in the city.

In the rush after electric motors, let us not lose sight of the fact that electricity is only one of the many physical forces by which we are surrounded, and that all such forces must be artificially excited.

If not one head of game were shot in England in the next twenty years, and, at the same time, if no vermin were destroyed, there would, in all probability, be less game than at present, although hundreds of thousands of game animals are now annually shot. Such is the destructive power of vermin.

DEATH IN DRAINS.

Trifling causes are often those that have the most weighty results. "'Tis the little rift within the lute that by and bye will make the music mute." Our neglect of simple hygienic precautions may end most seriously. We are glad to find the readers of SCIENCE SIFTINGS agree with us. In a recent article, entitled, "Look to your drains," we pointed out the evils that may come of ignoring the active nature of sewage, and believing that a septennial examination of the sanitary arrangements will grant immunity from the dangers of defective drainage. In the same article we suggested the antidote—a subscription to the "Science Sanitary Association," which is an undertaking instituted by us to protect our readers from these evils. We are glad to be able to announce that the support already accorded to the association has been such as to warrant the belief that it will prove self-supporting. We hope those of our readers who have not subscribed will at least write for prospectuses, which will be forwarded free of charge. Those who study their own well-being, and desire to conscientiously perform their duty to those dependent upon them, will certainly do so. Unsanitary dwellings are the great evil against which humanity has to contend to-day. Sewer gas is always active. If there be no defect in your pipes or fittings to-day, there may be to-morrow. We have antidotes for nearly all diseases; the antidote for the diseases from which thousands universally perish—we refer to the wasting away and the unconscious loss of vitality due to breathing impure atmosphere—is constant and efficient sanitary inspection.

The following extract from one of Dr. Corfield's lectures is so true and so valuable that we cannot help quoting it:—"Against all sanitary improvements whatever, we find one argument continually brought—that things have gone on in the same way for many years, and that there is no reason why they should be changed, that our forefathers lived under insanitary conditions, and why should we not do the same? That cholera, or enteric fever, or diphtheria has never broken out in a place, or in a particular house, and so it need not be expected! But these people forget that our forefathers died in these places, and that in *all* places which have been made cleaner, from which refuse matters have been removed more speedily, where overcrowding has been abated, where more efficient drainage arrangements have been carried out, the general death-rate has been lowered." In London, in the second half of the 17th century, the death-rate was 80 per thousand; in the 18th it had fallen to 50; in the first half of the 19th to 25, and now it is down to 17½ per thousand. The death-rate from zymotic diseases has fallen from 5·2 in 1840-50 to 2·24 in 1889. This passage was quoted by Mr. C. E. Gritton, A.M.Inst.C.E., M.S.A., in a most able paper recently read by him before the Society of Architects. The same well-known authority, in speaking of tests for detective drainage, goes on to tell us what happens directly the disconnecting trap upon the main drain becomes choked—and they frequently do. Sewage fills the drains, the occupants of the house for a time being unaware of any stoppage continue to use the fittings, and many pounds weight of falling water apply a hydrodynamic test, falling as they do upon the sewage locked in the pipes, and water being incompressible, the weak joint gives, and the sewage finds its way into or under the house. *This soakage, continuing in some cases for months or even years undiscovered, frequently illness in the house causing the first suspicion of anything being wrong.* Total stoppages of this kind have been caused within Mr. Gritton's experience, by oranges, chicken bones, hair cloths, grease, and other foreign matters. So well is the fact recognised, that even the most self-cleansing trap will sometimes become choked, that some surveyors have even suggested omitting them altogether! A warm house is very much like a sponge in water, in its capacity for drawing in air through the walls, floors, and every crevice. Experiments have been carried much farther in Germany than they have in this country, in the matter of the movements of "ground air." The one thing certain is, that if there is an accumulation of sewage or sewage polluted earth under or near an occupied house—aye, though there are seven feet or more of ground above it, the foul odours resulting will be sucked into the house. Forcible proofs of this have often occurred. These evils can only be detected in time to save damage by a competent sanitary engineer.

Not long ago a system of reconstructed house drainage, which had been carried out in connection with one of those large old houses which abound in the squares of London, was under inspection by a member of the staff of the *British Architect*. The occupant of the house was a medical man who, to parody an old proverb, evidently considered that "sanitation is next to physic." Having newly taken the house, and knowing that the sanitary arrangements of old London houses are not to be depended upon, he determined to have those of this house thoroughly overhauled and put into good order. When the engineer, Mr. Gritton, came upon the scene, he proceeded in the usual way to examine and test the drains with smoke and oil of peppermint. He found as a result dangerous leakages from drains and public sewer direct into the basement of the house, there being no intercepting trap whatever, and no proper joints to drains, so that there was free access to the house both for foul gases and sewer rats. When uncovered the drains were found to consist of very large pipes, irregular in line and gradient, laid in portions of the whole brick barrel drains which, together with the contaminated earth around them, had been left in from motives of economy or sheer ignorance. The soil pipe was a very ancient lead one, acting as a rain water pipe and also ventilating the drains and public sewers into the back bedroom windows. The w.c. appliances and traps were of the oldest and most defective types, and there was no ventilation at all to the drainage system (excepting the rain water pipes), which was also devoid of any means for access or flushing. The waste pipes to sinks, basins, etc., were in most cases untrapped, and in some instances directly connected with the drains. Unfortunately it is not only the drains in old houses that are defective. New houses are, only too frequently, sadly deficient. And even when perfection reigns at the inception, a weak spot somewhere may upset the whole of the architect's good intentions, and cause death and devastation to invade a healthy household.

A NEW VERSION OF AN OLD VERSE.

Scintillate, scintillate, globule vivific,
Fain would I fathom thy nature specific,
Loftily poised in ether capacious,
Strongly resembling a gem carbonaceous.

When torrid Phœbus refuses his presence,
And ceases to lamp us with fierce incandescence,
Then thou illumin'st the regions supernal—
Scintillate, scintillate—semper nocturnal.

SOCIAL SCIENCE.

Belief in Ideals.

So convinced are we of the need of faith in fine ideals, and of the possibility of working them out in the process of living, that we would make it the first lesson of education from earliest childhood up. We would make it the inspiration of home training and of school training. What can we make of a letter like this, from an educated man of marked ability as a thinker? "I am now 74 years old, but instead of growing more cheerful and assured, the reverse has been the case. Accordingly my present state of soul is lamentable and pitiful. Whether I shall end my life in distraction and insanity, or in confidence in myself and God, I can not say." Somewhere underlying such a mental condition there is a cause beyond the inevitable experiences of life. There is nothing in the tone of the writer to indicate that he is eccentric, anxious to be unlike the majority and prove his philosophic ability by an air of scorn. He may be sincere enough, and the trouble has been an inability to get from the outset a view of life from a right angle of vision. We have seen the letter criticised, with the conception foremost that the writer did not believe in immortality, and therefore held life itself in lessening honour. This may be true, but we do not understand why immortality should have so much to do with a manly and satisfactory career here and now. The dignity of living as an intellectual and moral power is something distinct and complete in itself. The grandeur of living is only lessened and cheapened by a curious speculation and inquisitive fretfulness about some other phase of life not yet comprehensible. This fretfulness is studiously encouraged and insisted upon by our methods of religious and secular training.

We are far from urging that we should eliminate from the present life all thought of a future existence, or more properly continuous existence; if only we will place it on the ground of natural science, and simply teach our young people so to live that they will be able to go forward into a protracted career of lives as they go forward into many years on earth. It is not altogether a disastrous worriment with anyone lest he shall fail of a good old age; why lest he shall fail of something beyond? Wholesome behaviour and obedience to rigid physiological laws insure as a rule long life. Why forget this? Why live with greed, gluttony, intemperance of one form or another, utterly reckless of the consequences in shortening as well as spoiling life while we fume and pray over a second existence? Education is viciously wrong. We should lay the burden on a correct and honest living of the present days. On the contrary, prayer for long life, and a healthy, happy four-score, seems to be of little importance. We are left from our infancy to defile our bodies with every destructive habit, but to obey certain religious observances that will secure us from future punishment. If this vast omission of care for the life that we have can be filled, there is no reason why we may not then, and not till then, look forward inquiringly into a future beyond the senses. But let that occur; let us have one whole generation taught to give heed to noble living, and we feel confident the whole problem of eternity will be readjusted. We shall cease to people the unseen with judgments of a supernatural sort, and with dooms of an arbitrary sort, and we shall equally cease from speculation as to the possibility of continued existence. A future life will seem to be a natural extension and continuation of what now is; and it will be very difficult to doubt it—that is, if we rise once to a grasp of the very right and grand nature of living, and place ourselves in harmony with the purpose of Nature—that is a beautiful life—it will seem so monstrous that the most beautiful should be created only to be obliterated, that we shall hardly be capable of the thought. Science has not brought us bluntly against scepticism, a wall of adamant, and said: "You can not see beyond; it is all a case of pure speculation, and any continued existence is more than improbable." It is, on the contrary, so insisting on the greatness and value of the present body and the present existence as to be conservative of force and individual persistence. We have, however, more respect for our educated man of good mental power, who has failed to live a life that looks out hopefully and peacefully, than for that man who stupidly exhausts himself on paltry thoughts, and expects without a doubt that some force is to pick him out of his grave, and forever fan the flame of his worthless embers. Having wasted nine-tenths of his value (his soul) he has the impudent confidence that he is to be prevented from wasting the rest—which he would surely do if he had the opportunity. We are very confident that we shall be able to reach a social cure for the evil portrayed. We believe in the future of *this* world.

Let us turn now to consider our aged friend from another standpoint. Is he not one of those who have reaped so much that he can not endure the thought of passing away from a world yet so fat with findings for an ambitious intellect? Possibly he is like Goethe, or like Humboldt, impatient of having only begun his research into the storehouse of facts, it is a wonder that, even then, his training shall have disabled him from the sublime confidence that sees that the result of all study and acquisition is character. That the right life loses nothing, but becomes permanent possessor of all its intellectual and moral acquirements, is the wonderful but patent fact of the human soul. The memory alone is a fact so astonishing as to overwhelm the pessimist with shame. The impossibility of forgetting stands to virtue and ambition as the *invention* of immortality. Nothing can die. The whole accumulation of philosophy and science, and equally all fine deeds and hopes of the simpler soul, weave together the imperishable texture of character. There seems to be not the least danger of the best things being swept away. Mind stands up assured that certainly *mind* will not obliterate whatever good is being wrought, or bring to confusion the noblest results of its own aims and purposing. This confidence of mind in mind is the final thought of science. We let it refine itself, and exalt itself into what we call love, yet it never loses the quality of faith. We believe in mind. We trust intelligence. We do not, we can not doubt the final good of a world permeated with intelligent results and intelligent aims. There are some things, it is replied, that look that way, and some do not. While only a shallow pate asserts the rule of chance, it is not easy to make everything accord with ruling wisdom. It looks like a composite. It has been the mission of evolution to teach a steady on-look and upward progress from the beginning. Ethics has been the aim of natural law from the dawn of life on the globe. History shows that human beings have steadily advanced in civilisation and enlightenment; that means in intelligence and morals. Earlier morals rarely went beyond the idea of doing to others as inferior to yourself. Slavery was universal; captives sacrificed. Natural evolution has carried us beyond these habits and ideas. Slavery is dead. War is at best abhorrent. Temperance is a recognised law; while justice and tolerance are creating a state of equity never dreamed of in earlier days. Survival does belong to the fittest; but the fittest unquestionably, in the judgment of Nature, are the honest and pure. Wrong-doing does kill. The licentious not only shorten their lives, and breed devitalising conditions, but they shorten the lives of their children, and die out in the

third or fourth generation. We shall learn to read the old Mosaic law with a nineteenth century candle, "For the Lord thy God is a jealous God, visiting the iniquities of the fathers on their children unto the third and fourth generation"—and no farther. Statistics show that degeneracy runs no farther.

We are not sure but the writer of the letter we have quoted is the victim of circumstances. He has trodden a hard and flinty road. He is not unacquainted with griefs, and no doubt losses of that sort that make the halls of the mind more empty than the granaries of the farmer in time of famine. He has seen death at work, and the destructive side of Nature has seemed as terrible and all-powerful as the constructive is wonderful and beneficent. He has been so often shaken in his trust in his neighbour that he has grown cynical. He does not quite trust God or man. This is a hard way to state it. Yet he does not state it much otherwise himself. "Whether I shall end my life in distraction and insanity, or in confidence in myself and God, I cannot say." It seems certain that he has lost hopelessly his trust in that arbitrary creative power that some have supposed created all things for his own pleasure, irrespective of the rights of the created. But, what is worse, he sees not anything to trust. He uses the term God, we suspect, ignorantly. What he means to say seems to be this: "I do not know whether, in defiance of irresistible fiats, I shall go distracted, and possibly kill myself, or whether I shall submit, and lie down contented not to have any will or purpose of my own, and so get peace by resigning my office as an intelligent purposer." Something of this sort is so common that we imagine it is what is in the mind of this man. Where is the escape? Clearly in getting rid of somewhat more of his heredity, and putting his faith in mind. It is possible for us to fully see ourselves as children of nature—the father and son; and while we cannot measure fully the purport, nor see the end, we can attain a confidence in interpenetrating goodness.

Can we build ideals with any hope of comparative success? Or are our most beautiful castles wholly at the mercy of circumstances, and for the most part so airy that they will not touch the ground at all? We believe in ideals. We believe that the truly moral will—educated to desire the really beautiful—see the beautiful, and enjoy it. Our blunders are mainly in two ways: (1) We do not teach our children to plan grandly; (2) we do not recognise the good that we get in our greed for what we do not reach. We have heard a vast deal about laying up treasures in the heavens, where moth cannot corrupt; with this we find no fault, if at the same time you teach us to lay up treasures of the same sort on earth, in spite of moth and thief. In all our experiences with men, and with the best Christians as well, we have seen very little earth-planning, beyond a house, a family, and money. These are the trinity of purpose. Is it any wonder that the confidence that rests on these three should be shivered? Not one of the three has elements of perpetuity—nor of satisfaction in the possession.

There is little to be said in approbation of one who professes to be a saint while dirty and dishevelled. Asceticism never made a hovel anything but a hell. Our outside surroundings are, and ought to be, the setting of our character. We are as much bound to design the beautiful in things as in thought. A foul soul may yet have some fine artistic taste; a vile body may have some glowing ideas. The divorce is unnatural. When we get to a materialism that is penetrated with spiritualism we shall have homes and souls equally lovely, and certainly realisable. What we urge is the constant suppression of whims, and the constant inculcation of manly courage. We believe that step by step, as we are capable of seeing the excellent, we are equally capable of working it into shapes of reality. We can surround ourselves, if we will, with that which we hold to be admirable. Your soul, your real self, repeats itself in the kind of children you breed, and the house you build, and the garden you plant. It is impossible for a finely tempered mother and father to beget detestable offspring. Where there are evil results there are, you may be sure, adequate causes. We must teach the next generations that they are not only responsible, but that they have vast power over themselves and their surroundings.

THE DIVINING ROD.

The divining rod possesses, or rather it was supposed to possess, qualities only less important than were attributed to the elixir of life and to the philosopher's stone. But it was agreed in the case of the divining rod that it has a real analogy in the magnetic needle, which, as all mariners are aware, responds with dangerous facility to the influence of certain rocks. And it may be for this reason that, to the present day, a lingering belief in "divinations" for gold, silver, and other metals exists in the minds of even some well-educated persons. Few Londoners may realise the demand in which "water finders" and their analogues are held in new countries, as, for instance, in the Western U.S.A. But as inventors rarely stoop to consider the "demand" for their productions, it is perhaps superfluous to remark that a rich golden harvest awaits the discoverer of any "action at a distance" by which the location of a a buried mass of lead or copper or other metal or of a spring of water can be determined. We do not know precisely what disturbances may be induced in ether by the complicated heat vibrations and other motions of the molecules of solids. It is probable, however, that some of the constituents of that "radiant heat" which is constantly emitted by all substances, may be closely analogous to the waves of "radiant electricity," and may be possessed like them of what we should call, in vulgar language, very penetrative qualities. This disregard of intervening matter is shown in a high degree in the propagation of gravitative force. And if we had spring balances sufficiently delicate and accurate they might furnish valuable indications of the varying densities of underlying strata at various points in the earth's crust. A more striking proposition has, however, been made with respect to the subject of this article. It is to utilise the fact that the recently-discovered electrical radiations are capable of penetrating non-conducting media but are reflected by conductors of electricity. It is proposed that the reflection of these radiations should be made the means of determining the location of the hidden minerals. We cannot quite bring ourselves to believe in this scheme, although it is interesting from a theoretical point of view. We think that the transmission of "electrical radiations" through brick and stone walls has been talked of too glibly, and has given rise to some erroneous impressions. It may easily be that (for example) a wooden door is transparent to the radiations, just as a glass plate is to light; but, on the other hand, that a succession of irregularly shaped "transparent" substances may exhibit almost complete opacity—the effect of selective absorption and of scattered reflection. These matters have to be carefully reckoned with before we can talk very confidently of divining by Hertzian vibrations, or of establishing a "company for the Transmission of Cheap Power to the Antipodes."

TO INVENTORS.—Anyone having a good Invention can, on applying to the Editor, "Science Siftings," obtain the advice and assistance of a well-known Patent Expert, free of charge.

RESEARCH AMONG THE INFINITESIMALS.

Science has turned from the observation of universes to research among the infinitesimals. Nearly all discoveries of greatest importance for the last quarter of a century have dealt with trifles. Prof. Koch only leads on a track fairly well established. It was granted, or taken as granted, that a certain set of diseases were incurable. They were, from the old point of investigation. We had no knowledge of micro-organisms. No one dreamed that at the bottom of our vital statistics we ought to write "died of the attack of a creature so small as to be contemptible ;" "killed by what can only be detected by a microscope." But the first glimpse of this danger came, and the wisest scientists prophesied a total revolution of the science and art of healing. Now we know ourselves as waging the most vital war with the invisible enemies of the air. But most wonderful of all is the latest discovery that there are free cells of the blood that attack and destroy a very large majority of dangerous bacilli. Unconsciously we are more capable of meeting such foes than we are consciously. The problem is now for conscious powers to devise means for rendering innocuous the remainder of these infinestimal destroyers. This is the work of such laboratories as that of Koch. We have but few diseases unconquered, and not one that we any longer recognise as incurable, whatever may be the result of one or more supposed remedies.

In the light of recent research we may ask if there is such a thing as an atmosphere ? In the sense of a world envelope, made of oxygen and nitrogen, nothing of the kind is about us. That which really surrounds the earth, and which we breathe, is made up of dust. A sea of dust enfolds the earth, made up of an almost infinite variety of materials. Many of them are poisonous, and others liable to find in us a suitable field for development ; and then a colony of death causes fevers, and puts an end to our organism. Dr. Marcete, a former President of the Royal Meteorological Society, has recently published his investigations in atmospheric dust. The marvel is not that we are sometimes the victims of the air, but that we do any of us escape speedy annihilation. The appearance presented in a room where the sunshine enters through a crack is not apparently true, but literally true. It is this sort of stuff that we breathe. It enters the body at more or less advantage to take root or make itself at home. For in this vast cloud is a large proportion of minute living organisms. Our only defence against these infinitesimal enemies is to keep our own organisms in a condition to resist. In fact very little has been yet found out about these motes. But this we do know, that when there are diseases the germs of such diseases are likely to be found in this air dust. We also know that it is in some cases a serious irritant to flesh, and more especially the mucus membranes, or the lungs. In other cases this dust may be inflammable, as that about our flouring mills. We are only on the threshold of knowing the secrets of the atmosphere ; but what is known, is not all pleasant to consider. We have substantially fought and conquered the animal world ; but the insect world and the bacterian world are very closely our match. It is a question whether a human generation will ever exist that will have mastered the air and what it contains. If this victory ever is ours we shall live very different lives, with an immunity from a thousand torments and tortures that invest comparative health, as well as immunity from fatal diseases that carry off half the generation.

WAVES exert a force of one ton per square inch when they are only 20 feet high. At Cassis, France, granite blocks of 15 cubic metres have been moved by wave force.

MAGNETISM.

In tools it is due to a combination of position and vibration.

It is well known that vibration greatly assists change in the magnetic state of a piece of iron placed in a magnetic field, and Ewing has shown this quantitatively by a series of curves derived from actual experiment.

The phenomenon of hysteresis, or the lagging of a magnetic effect behind its cause, which is existent in all qualities of iron and steel, in soft annealed iron least and in hardened steel the most, is almost entirely obliterated in the former, and greatly lessened in the latter, when the bar is subjected to vibration.

A simple experiment, described by *Electricity*, within the reach of nearly everyone, to show this effect, is the following :—

If an ordinary wrought iron poker be held in a vertical north and south plane and one end be dealt a sharp blow, it will be found to have assumed polarity, which may be proved by presenting the ends in turn to the north-seeking end of a compass. One end of the poker will attract and the other repel. If now the poker be reversed in position and the other end tapped, the polarity will be changed, and the end which formerly attracted the north end of the needle will now be found to repel it.

The maximum effect is produced when the bar is held parallel with the dipping needle, and it gradually disappears as this angle is departed from, until, when held at right angles to the dipping needle, no polarity is developed by the blow, and if the bar already have polarity, it may be completely removed by striking the bar when in this latter position.

Since a dipping needle may not be accessible, this latter effect may be easily produced by striking the bar when held horizontally in an east and west position. It will then be at right angles to any vertical angle in a north and south plane. As before stated, the bar will acquire no polarity if struck when in this position. This is not strictly true, however, as it would be magnetised transversely, but its dimensions in this direction being so small compared with its length, the magnetism would be too slight to be detected in the ordinary way.

In the example given, the magnetic field is due to the earth's magnetism, whose lines of force take a nearly north and south direction and tend to thread an iron bar held parallel to them. The magnetic reluctance of the bar, or the resistance which its molecules or molecular magnets offer to an arrangement in conformity with these lines, is overcome or lessened by any means of molecular vibration. In some cases the mere tremor of the earth is sufficient in this magnetic field to permit of this rearrangement. In others it requires a more violent vibration, such as may be caused by heat, by friction, or by a blow, and it not infrequently happens that these agencies must be long continued to produce appreciable results.

The magnetic reluctance of different samples of iron or steel varies not only with their quality and temper, being least with soft annealed iron and greatest with hardened steel, but also with the past history of the bar in question.

It is found that a bar which has once been magnetised in a given direction and demagnetised will more readily again take magnetism in the original direction than in the opposite one, and although two bars may be of identically the same composition and hardness, they will vary in their susceptibility as the stages through which they have passed in the course of manufacture have varied. So that it has been well said that the susceptibility to magnetism of a given bar is the resultant of all the influences to which it has been exposed in and since its manufacture.

A HOT-BED OF GERMS.

It is generally admitted that healthy organs and tissues, whether animal or vegetable, do not contain bacteria, bacilli, or other micro-organisms, indifferent, obnoxious, or useful. However, it is also well known that the blood, the spleen, and other parts of tissues, while seeming perfectly normal and healthy, do positively contain such micro-organisms, which have been noticed and described by a number of investigators. In many cases it has been argued that the demonstration was unsatisfactory—that the living germs were of external origin, and had got in by some accident; so that a method, a reliable method, for the investigation of such organs or tissues supposed to contain—or not to contain—germs, is much wanted. This method M. V. Galippe, of the Paris *Société de Biologie*, has tried to obtain. The ways and means of his experiments have been the following:—He takes it for granted that if an organ or a tissue contains no germs at all, then, if this organ or tissue is kept in a place where the common germs of the air and water cannot obtain an entrance, no germs can ever be observed in these tissues, and they must disintegrate slowly, without any putrefactive process of any sort. And, by similar reasoning, if these same tissues or organs, which are considered as containing no germs at all, are kept in places where external germs cannot arrive, no germs at all can be detected in the organ or in the space it occupies. And M. Galippe says, of course, that if a healthy organ or tissue, aseptically taken from the organism and placed in a space where no germs exist, does develop germs, it must necessarily be concluded that the germs existed in the tissue or organ. M. Galippe's experiments have been conducted in the following manner:—A spherical glass vessel, with a rather long and wide neck, which is narrowed in its middle portion, containing some broth, and shut with a plug of cotton, is sterilised by the usual means at a high temperature. The organ or tissue under investigation is then taken from the plant or animal, in a room where every part of the ceiling, floor, and walls has been thoroughly washed with some aseptic and antiseptic solution, such as *sublimé corrosif*; or, rather, in a part of such a room, under a tent made with cloth which has been thoroughly soaked in the same solution, and remains yet wet. The operator himself has washed his hands and face with the sublimate, and over his clothes has put a long linen blouse, also wet with the solution. The organ is extracted, or the tissue severed from its normal connections, under this tent, and introduced into the glass vessel—not in the broth, but in the neck of the vessel, above the narrowest part, which keeps it from falling down into the broth. M. Galippe supposes that no artificial preparation can be well suited for the cultivation of the germs which are supposed by him to exist in the organs or tissues, as the latter, and this is the reason why he keeps them out of the broth. But, on the other hand, it is very useful to have the broth, because micro-organisms which could escape detection on the surface of the part examined, cannot do so when in the broth. In order to insure the development of germs in the broth, if any are present, it is enough to incline the tube now and then, in order to allow the broth to imbibe the part and take away some germs. We cannot enter into all the details of the experiments, which have really been conducted in a very satisfactory manner, with great care and caution—perhaps more than was absolutely necessary, but there was no harm in it, of course—and it is enough to say that from the experiments of M. Galippe it follows that germs exist in all normal and healthy tissues, more or less. The fact must, of course, be corroborated by numerous experiments, and they are being made; but is doubtless quite exact, showing that our ideas concerning the complete absence of germs in tissues or organs, not in communication with the exterior, are erroneous.

THE LOSS OF OLD AGE.

The type of essay *De Senectute*, of which Cicero gave us the model, is not much affected now. Perhaps the Roman orator exhausted the sentimental and philosophic side of the subject. At any rate, the view of old age which most interest moderns is not how to enjoy it, but how to get and prolong it. Perhaps this is really the essential thing, since it appears as if, despite sanitation and all our modern improvements in living, old age is gradually slipping away from us.

It is true that we have immensely lessened infant mortality and extended the mean duration of life to over forty-five years. But the average number of old people is not correspondingly increased, and it is even charged that when great old age is now reached, it is abnormal and the evidence of a deep-seated neurosis whose penalties are visited on succeeding generations.

The foregoing statements are not vague generalisations, but based upon carefully collected vital statistics. Sir James Crichton Brown, in a recent address on old age, states that since 1859, in Great Britain, the decline in the death-rate has been 17·5 per cent. at all ages under fifty-five, and only 2·7 at all ages above fifty-five. Between the years sixty-five and seventy-five there has actually been an increase in the death-rate.

The cause of this increment in later death rates is attributed to cancer, heart diseases, nervous diseases, and kidney diseases. These diseases are mainly of the degenerative class, and due to the wear and tear of modern life. This is shown by the fact that the death-rates after forty-five are less among women, and less in the country than in the city.

Dr. Brown gives the further discomforting reflection that men and women are growing old before their time. "Old age," he says, "is encroaching on the strength of manhood, and the infirmities associated with it are stealthily taking possession of the system some years earlier than they were wont to do in former generations. Deaths due simply to old age are now reported between forty-five and fifty-five years of age, and in large numbers between fifty-five and sixty, and there has been a reduction in the age at which atrophy and debility—another name for second childishness—kill those who have passed middle life. Presbyopia, or the long-sightedness of old age, in which near objects cannot be distinctly seen unless held at a considerable distance from the eye, is believed by some experienced ophthalmologists to begin, as a rule, rather earlier than it used to do. No trustworthy statistics on the subject exist, and, of course, general impressions ought to be received with caution, for it must be difficult to distinguish how far the early recognition of ocular failure in these days is attributable to the increased care bestowed on the eye, and how far it should be ascribed to untimely invasion, but I certainly attach great weight to the opinion of Mr. Critchett, who says, "My own experience, now extending over a quarter of a century, leads me think that both men and women now seek aid from glasses at an earlier period of life than their ancestors." Very significant also is the statement of Mr. Brailey that "people who have lived long in hot climates like India, become presbyopic four or five years earlier than they would otherwise have done," for life in a hot climate really means excessive wear and tear to a Euro-

pean. The ordinary age for the adoption of spectacles for reading used to be fifty; it is now, I believe, nearer forty-five."

The teeth are dropping out earlier, baldness is more prevalent, senile insanity is more common, and appears sooner than it used to do; suicide is increasing, and most suicides occur between the age of forty-five and sixty-five.

This is rather a doleful outlook, and one naturally seeks to know if Dr. Brown has a remedy for the ills he portrays. "There is," he tell us, "no short cut to longevity. To win it is the work of a lifetime, and the promotion of it is a branch of public medicine. Perhaps one of these days we may have an International Congress on Old Age, with an exhibition of dotards for warning, and of hale and hearty centenarians for encouragement. At any rate you may rest assured that it is by steady obedience to the laws of health that old age may be attained, and by judicious regimen that it may be prolonged."

This is all very true, but, unhappily, it has been well known since the days of Hufeland. Perhaps the best and only thing that we can do, says the *Medical Record*, is to teach children more earnestly the fact that to enjoy the last half of life they must take care of the first half. The maxim, "*Dum vivimus. vivamus*," is the one which above all makes old age a sickly and unhappy one.

POPULAR SCIENCE LECTURES.

THE popular science lectures on Tuesday evenings, at the Royal Victoria Hall, Waterloo Bridge-road, are meeting with deserved success, under the able management of Miss Cons. The following is the programme for the remainder of this month: March 8th, (to-night) "Sound and Music," by Prof. A. W. Reinold, F.R.S., with experiments. March 15th, "Iceland," by Dr. Tempest Anderson, B.Sc., F.G.S. March 22nd, "The Sole and other Sea Fishes," by Prof. Weldon, F.R.S. March 29th, "Elephants," by A. Smith Woodward, Esq. The optical lantern plays an important feature in the illustrations at these lectures, and proves its great utility as an aid to the exposition of popular science.

ANSWERS TO CORRESPONDENTS.

Questions to which answers are desired in this column must NOT *be marked "Science Queries and Answers."*

C. B.—We regret we cannot use your contribution at present.

THOMAS WATSON.—You do not state your age, but we take it for granted you have attained maturity. Your case is not unusual, nor is it necessarily the result of nervous or other debility. Many fail in conversational power who are otherwise extremely intelligent. It is only your *fear* of breaking down that cripples you. You require more confidence in yourself and your opinions. To attain this, follow the example of Demosthenes—practice in private, hold imaginary conversations, and you will soon acquire the necessary readiness for public conversation. We shall always be glad to hear from you.

S. J. TAYLOR.—We regret that our article "Triumph over Trichinosis" should have occasioned you any discomfort. Our authorities for stating that trichinæ originally came from the rat, are the Special Commission appointed by the United States Government to inquire into the matter, and Dr. Leuckhart, of Leipsic, and we are fully convinced, therefore, as to our accuracy. You ask, do the Chinese, whom you believe to be rat eaters, suffer from the pest? If the Chinese are rat-eaters, and it appears to be the popular belief, it may chance that the rats of China are exempt from the disease; or, still more likely, the Chinaman may, by inheritance or natural selection, have acquired immunity from the attacks of this dangerous parasite.

CHARLES WILTON.—We think that the sideways motion of the tyre that would result from the use of elastic spokes would be objectionable. As, however, your suggestion is not a novel one, you could not patent it, and we should not, therefore, recommend you to spend time upon working it out.

L. ARTHUR LANCASTER.—(1) Write to Mr. J. Fielding, Bromley, Kent. (2) Yes; the tonic effect resembles that resulting from electrical treatment. A detailed explanation of the views held by physiologists on this subject would occupy very much more space than we can afford to give in this column. (3) It must be admitted that most artificial lights are more or less injurious, inasmuch as they are different in hue from that to which the construction of the eye has become adapted by natural processes. We find that from this point of view, gaslight is inferior to that of a paraffin lamp, and still more so to the electric light.

A. C. WILKINS.—Thanks for your suggestions, which are impossible with our present advertising contracts. They will, however, be kept before us. The first volume will be completed five weeks from this date, with No. 26. Covers for binding will, in all probability, be supplied.

W. L. S.—Thanks for communication. "Paint," in reply No. 20, p. 277, was a misprint for "print." Please remember that the answers published are selected out of many hundreds of communications. We do not, as a rule, feel disposed to add to or amend them. In this particular instance we may state, however, that "soak" should be understood simply as "soak," *i.e.*, "saturate"—there is no question of time. Then "potash" is well understood to be synonymous with potassium hydrate.

A. MACIVOR.—Your answer to query no 39 is an excellent one. Brevity and conciseness of expression are, however, of importance to us since space is so limited. Many accurate answers are rejected by reason of their length alone.

R. A. KENNEDY.—Yes. The reason is principally that on the date in question the earth's north pole is inclined, towards both sun and planet. The angle between Venus and the sun will be about 47°, not 44°. The time of greatest elongation east is not May 10th, but April 29th next.

F.H. W.—Thanks for your communication, which is very interesting. The facts are in accordance with our own experience. We cannot, however, make use of the query.

E. FISH.—No. We can give no explanation whatever for the alleged phenomenon in question.

PHONOGRAPH.—A layer of white wax is often used; but the removeable covers you speak of are simply sheets of tinfoil.

WM. SHIELDS.—Kola nuts are the brown seeds of the *Sterculia acuminata*, a native of tropical Africa. It is said that by chewing them the flavour of anything that may be eaten immediately afterwards is much improved. The belief that the nut is a valuable article of food has never been authenticated.

INDUCTION.—Your current may be too strong. What battery power do you employ? More probably the so-called platinum strips are made of inferior alloy. Or, it may be that the platinum strips have been unskilfully attached by means of tin solder, and that, in consequence of the solder having flooded the surface of the platinum a fusible and rotten platinumtin alloy has been formed, which is the cause of your trouble.

H. J. C.—What may be the best way of enrolling yourself as an apprentice to electrical engineering depends wholly upon the extent of the electrical and mechanical knowledge that you possess. If you are without such knowledge, three courses are open to you. First, and preferably, you may pay a premium for apprenticeship to electrical engineering with some firm of established repute. Or, secondly, you may study "theory and practice" in a technical school. Or, if young, you may enter the shops as an ordinary apprentice, that is to say, as a workman, and trust to your own efforts and ability to improve your position. What is chiefly necessary is proficiency in mechanical engineering. This must be acquired in the workshop. Mathematics and electricity can be learned from books.

GERMANIC.—Yes. You could harden lathe drills in the way you mention. You would do better, however, to make use of oil or other fluid in the ordinary manner.

MANX.—They are black, a fact so well known that we cannot see our way to make use of the question.

PASTE.—A little carbolic acid will prevent souring. Add, say three or four drops in a cupful.

S. RICHARDS, W. L., AND ALPHA.—We have already explained that as hundreds of answers are received every week, it is impossible that more than a small percentage of correspondents should be satisfied. We also receive very many interesting questions that are necessarily crowded out. As the questions are preserved, however, it is quite possible that yours may yet appear in a future issue of SCIENCE SIFTINGS.

AMATEUR.—You can make tin solder by fusing together equal parts of tin and lead. It is as cheap to buy it ready made, however. The "soldering fluid" is a solution of chloride of zinc made by adding scraps of zinc to a little muriatic acid until the effervescence—that is the evolution of hydrogen—has ceased.

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Books. Foster's Physiology, 6s. 6d., Mantell's Medals Creation (2 vols.), 4s., Wakefield's Botany, 1s. 6d., Hitchcock's Religion Geology, 9d., Walls Manual Photo Colouring, 1s., Daniell's Intro-Chemical Philosophy, 1s. 6d., and nearly 3,000 others. State wants, Miss Trimming, 17, Junction-road, Hackney Downs.

Wanted, small metal lathe. Send lowest price and description by letter only. George Bulbeck, 22, Sussex-street, Pimlico, S.W.

Two fine stuffed otters, 30s. each, for sale: natural ferns, artistically painted, 1s. 3d. doz. free, 10s. gross. Travis, Bury, Suffolk.

Wanted, magic lantern, 4 in. condensers; good make, latest improvements; portrait lens. Approval. Wood, Central Buildings, Stockton-on-Tees.

Shew's eclipse hand camera, ¼ plate, fitted with ½ plate lens, 3 double backs, and case. Cost £7 5s.; price 90s. H. Dicksee, 87, Canfield-gardens, N.W.

Kodak No. 1, nearly new. Cost 105s.; about 50 unused films, price 60s. Everard, Chichester.

Twelve species land shells, 12 species fresh water, 24 species marine; altogether 150 specimens; all localised, unmounted; 9s. 6d., carriage paid. Bargain. Wm Blake, Broad-street, Ross.

Incandescent electric lamps, small, cheap, low voltage. Post free, 7d., stamps. P. Rowsell, 1, Walcot-square, London, S.E.

Powerful magnetic machine, with regulator, brass handles and fittings complete, polished box, nearly new. Cost 25s.; sacrifice 12s. 6d. Gouldburn, 16, Maryland-square, Stratford, Essex.

Magnetic battery, nearly new. Cost 25s.; 12s. 6d., or exchange fowls. Oakhurst, Bexhill.

Wanted, intensity coil, with commutator to give a 2 in. spark. Thomas Schofield, Harefield, Rochdale.

New marine, field, and opera glasses combined. Cost 40s.; take 25s. Hellier, 30, Portland-street, Southampton

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Valuable binocular microscope, in mahogany cabinet, extra accessories. Offers. Freemantle House, Boscombe.

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Detective camera, perfect order, some plates, 5s. 6d., or exchange. H. P., Molescroft, Eastbourne.

Aquarium plants, grand assortment, 1s. 3d. post free; every aquarium requisite; gold fish, 3s. doz. Samuel Newton, Naturalist, Hollow Stone, Nottingham.

Trouve's photophore, complete, consisting of 2 lamps and plated fittings, in velvet lined case, and 4 cell battery, in lock up oak case, 50s. Wood, 61, Ann-street, Plumstead, Kent.

Wanted, entomological appliances; also larvæ, pupæ, and eggs. P. R. Alford, 7, Sydenham-rise, Forest Hill, S.E.

Ship's chronometer wanted. Send price, maker, name, and particulars, B., Stirling House, Basingstoke.

Wanted, set of bones, cheap, with or without skull. Davies, 21, St. Mary's-terrace, Paddington, W.

Good microscope, by Dale, condition as new. Price 50s. Smith, 2, St. Martin's-road, Norwich.

Wanted, good minerals. T. Stock, 16, Glen-park, Eastville, Bristol.

Splendid stuffed crocodile, 5 ft. long. Price £3. Woodend, Pitt-street, Liverpool.

Wanted, lion or tiger skin. W., 3, Albion-terrace, Gaywood-road, King's Lynn.

Wanted, cheap for cash, 2 stuffed fish for otter's paw. Stilwell, Stillinghurst, Haslemere, Surrey.

Bargain. Five pairs wild bock horns from the Cape, ready for mounting. Only 12s. 6d.; worth double. Doughty, hairdresser, Canal Walk, Southampton.

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Superior binocular telescope, with bending joints, in sling case. Price 50s., cost double. A. D. S., Alpha House, Barrett's-grove, Stoke Newington-road, N.

Half plate leather bellows camera, extends 17 in., rack and pinion, swing back, rising front, 3 Tyler's patent double slides, 28s.; Lancaster's ¼ plate wide angle rectograph, 18s.; No. 2 demon camera, complete, plates, chemicals (5 extra), plate holders, 8s.; all perfect. No approval. Grant, Lockranza, Arran.

Wanted, model vertical boiler, about 11 in. by 7 in. F. Green, 21, Grosvenor-street, London, W.

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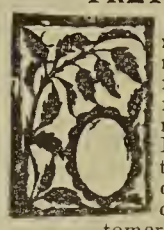

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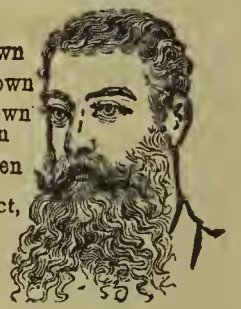

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SCIENCE NEWS AND NOTES.

"We are not born here on earth primarily that the world may feed, and aid, and warm us, but that we may feed, and aid, and warm the world."—CANON HOLLAND.

It is Our Pleasant Task

to continually strive to place some pleasant and novel surprise before our readers. We think the announcement we make this week on the opposite page may well come within this category. We offer each of our readers, who will trouble to cut out the coupon and forward it to us, together with half a guinea, a handsome portrait of himself or herself, printed on most beautiful white porcelain, measuring ten inches by eight inches and finished by hand. It will be manifest that we make no profit out of these porcelain portraits, as they are identically the same as those supplied by London photographers at two guineas each. Our only object is to create a sensation and thus increase the circulation of SCIENCE SIFTINGS; therefore it will answer our purpose as well if our readers will send us new subscribers. To this end we will present one of these beautiful portraits, *free of charge*, to every one sending in four annual subscriptions of six and sixpence each, every subscription to be for a separate individual. As the excellence of these portraits depends on the clearness of the photograph we copy from, we trust our readers will remember this.

Drunkenness and Insanity

appear to be very much akin as far as symptoms are concerned, and it is quite easy to conceive from the evidence of Dr. Hughlings Jackson, F.R.S., that many cases accepted as dipsomaniacal by laymen—the police authorities, for instance—are entirely dependent on cerebral excitement, having no connection whatever with the consumption of intoxicants. There may be, it should also be pointed out, insensibility, and manner and conduct like that of a person partly intoxicated by alcohol, solely arising from grave intra-cranial injuries or other morbid conditions. Many cases have shown such identical symptoms one to the other, that diagnosis has been found next to impossible. A most important matter is that for an hour or two after injuries to the head there may be a condition very like that of a man slightly drunk. In the case of a clergyman charged with drunkenness—a serious thing for a clergyman—Dr. Jackson was able to say that the condition described might have resulted from an injury to the head the patient had had. It is to be borne in mind that after an injury to the head, a patient may act elaborately, if foolishly, whilst "unconscious"; that is, on his recovery he remembers nothing of his strange doings—a thing evidently of medico-legal importance, and a scientific fact that we commend to the notice of magistrates and police authorities.

Sea-Sickness

has engaged the attention of the medical faculty from the most remote periods, and although the cause is fairly well understood, the universal cure has never yet been discovered. Certain people swear by certain remedies, but our experience is, that what suits one constitution is entirely useless to another. Dr. Charteris gives a variety of palliatives, in a recent issue of the *Lancet*, and stakes his reputation on their efficiency—but the stages of sea-sickness are varied—and even these are of doubtful potency in all cases. If we take a professional view of *mal de mer* we may say, more especially in relation to the treatment to be adopted, that there are two stages : first, pallor, nausea, vomiting, which is succeeded by a second stage, of exhaustion, retching, depression, and in many cases sleeplessness, or sleep not refreshing in its nature and attended by dreams of a painful character. The approach and duration of the first stage varies, but when begun it continues until the stomach is empty, and is succeeded by the second stage, which may be prolonged for a more or less indefinite period, in many cases extending even over the whole voyage. The first stage is the most difficult to cope with.

The Voluntary Muscular Contractions

or rather, the influences that affect them, form the interesting subject of an article in the *Journal of Physiology*. It is written by Dr. Warren P. Lombard, Professor of Physiology in the Clark University, Massachussets. His essay is an endeavour to ascertain what are the influences which determine the activity and fatigue of the central nervous mechanisms exciting the voluntary muscles to action. The influence of surrounding conditions, or, as Herbert Spencer terms it, of our environment, is more or less distinctly recognised by all. To one man, light, fresh air, and freedom of movement, whether in the form of hunting, or fishing, or mountaineering, are essential to the enjoyment of life. To him the

confinement and restricted activity of the literary student are insupportable. To another, a free supply of food is an absolute necessity, whilst yet another will be happy on the grey peas and water diet of Friar Tuck. Some feel wine, or some substitute for it, and tobacco to be indispensable; others can cheerfully dispense with either or both. Charles Dickens required the bustle and activity of a great city to stimulate him to his best efforts. Wordsworth preferred to commune with nature alone. But in every instance the influences of the great forces that surround us, as well as of the minor agents, may be traced in the vigour and energy with which the ordinary avocations of life are performed. There are fluctuations both of muscular and nervous power which are manifested in the quantity and quality of the work done, whether this be the production of a "Messiah" or of an "Alexander's Feast," or in some violent and protracted muscular effort.

The Interesting Experiment

carried out by Dr. Lombard need not be entered into *in extenso*. Suffice it to say that he ingeniously proves his contention that, even when fatigue is complete, on continuing his efforts to raise a given weight, periodic returns of power were observed, which were probably of central origin. Speaking broadly, muscular power is greater in the morning than at night, though this is liable to vary under the influence of meteorological conditions, and the fall of the curve of power through the day is checked at regular intervals by the meals. The effect of exercise was very noticeable in increasing the power, which is very encouraging to those flaccid inhabitants of large towns who endeavour to renovate their debilitated bodily powers by moderate exercise in the open air for a month or so in summer or in autumn. The effect of alterations of atmospheric pressure has been carefully examined by him, with the interesting result that, though no constant relation between the work and the absolute atmospheric pressure was found, it was noticed that the power often increased when the barometer was rising, and decreased when it was falling.

The Influence of Tobacco and of Alcohol

was finally investigated by Dr. Lombard, and with results that are certainly remarkable. These drugs seem to have an antagonistic effect. Tobacco acts rapidly as a depressing agent, and its influence quickly passes away. Alcohol, on the contrary, acts as a stimulating agent, and it increases the endurance of the muscles. In one experiment with tobacco, the total work in kilogrammetres at 8.30 a.m., was 10·25, but eighteen minutes after smoking a cigar of medium strength, the total work fell to 6 kilogrammetres, and an hour after to little more than 2 kilogrammetres. But at 11.30 a.m., it had risen again to 10·25. This is a result well worthy of the attention of all smokers about to engage in any physical contest. The effect of alcohol is not less marked in the opposite direction. The whole of this communication is very suggestive, and the *Lancet* considers it deserving of the careful attention of physiologists and of physicians.

Opium as Alcohol

is constantly the subject of statements and claims from different standpoints. We recently published the bitter cry of the antagonistic party in India, which claimed that personal observation had shown the fearful evil being wrought by the drug. On the other hand, we have a mass of official Indian testimony, which is opposed to the view that the use of opium has gravely prejudiced the health of our fellow-subjects in that country, that it is decidedly increasing, or that its manufacture there has any marked influence on the maintenance of opium-eating and smoking in China. According to this evidence, not only is the drug, if used in moderation, not injurious, but it is in some cases—notably those of persons exposed, as in Assam and Eastern Bengal, to damp and malaria—positively beneficial; it is conservative of physical endurance, it enables the consumer to live healthily on less food than he would otherwise require: it does not, as asserted, cloud his mental faculties, and, even if hurtful, it is so by reason either of adulteration with Indian hemp or of excessive indulgence. We observe, however, that even these advocates of its utility do not deny the capacity for mischief possessed by opium if indiscreetly taken. This fact, in our opinion, is quite sufficient to justify its restriction to purely therapeutic uses, the more so that it is, if we may trust the teaching of modern observation, by no means the best safeguard against malaria. The *Lancet* sees, but one way of escape from the difficulties which surround this question—that is, the legal restriction of opium to its use for purely medical purposes.

An Infernal Method

of wiping out an enemy by electricity was recently suggested by Mr. Edison. Our notice of this method was ridiculed by an electrical contemporary; but the description was necessarily incomplete owing to the fact that we only received it by cablegram. We are now able to give Mr. Edison's proposal in his own words. He suggests as a means of defence or attack in war to devise a way by which electricity may be poured out from a hose upon an enemy as water is thus thrown out under great pressure. He says that with 25 men in a fort he could make any fort absolutely impregnable, so far as an assault is concerned. This is not guesswork, but a matter of scientific certainty. "Some years ago," he says, "when the wires loaded with heavy electric charges began to go underground, I predicted that there would be danger of the firemen receiving a deadly shock by the electricity running down the streams of water which might cross the wires. In each fort I would put an alternating machine of 20,000 volts capacity. One wire would be grounded. A man would govern a stream of water of about 400 pounds pressure to the square inch with which the 20,000 volt alternating current would be connected. The man would simply move this stream of water back and forth with his hand, playing on an enemy as they advanced and mowing them down with absolute precision. Every man touched by the water would complete the circuit, get the full force of the alternating current and never know what happened to him. The men trying to take the fort by assault, though they may come by tens of thousands against a handful, would be cut to the ground beyond any hope of escape. Foreign soldiers undertaking to whip America could walk around such a fort, but they could never get through it. It would not be necessary to deal out absolute death unless the operator felt like it. He could modify the current so as simply to stun everybody, and might then walk outside his fort, pick up the stunned generals and others worth keeping for ransom or exchange. He could also make prisoners of the others if he chose to do so."

Execution by Electricity

has now had a fair trial in the United States, and it cannot be claimed that it has proved successful, although it must be conceded that its adoption was on humanitarian grounds. We are, however, pleased to learn that in deference to popular opinion, the State authorities are about to recon-

sider the question with a view to its abolition. It is quite time; for the last "electrocution" was even more revolting than any previous one. The *Medical Record* of New York says (while admitting that all the victims have been killed): "In every case repeated strokes were necessary, with torturing intervals for discussion and disputation among the scientific experts; the grim tussle with death timed by stop-watches, while the victim was writhing between scorching electrodes. The details of the dreadful business transcend in cool brutality anything that can be imagined, and yet we are assured that this is the new and approved way of doing a victim to death." These terms are neither too strong nor too condemnatory for experiments—they are nothing better—that cause intense suffering, even if more by anticipation than realisation, to human beings. Hanging, as was pointed out recently in our "Queries and Answers," is undoubtedly a most humane method of carrying out the laws of society when they involve the sacrifice of human life.

The Relation Between the Aurora and the Weather

is the subject of a further communication from our valued correspondent, Mr. E. Kennedy. This gentleman told us that intense heat or cold would be experienced in those places where the aurora was seen. We have not observed much of the aurora over England this year, but we are placed between the American and Swedish displays, therefore Mr. Kennedy expects a warm spring in England; a cold one for America and Sweden. The contention that the aurora is always followed by intense cold has certainly proved accurate in the case of the recent displays of the phenomenon in Sweden and Northern Russia. We learn that in the first-named country the thermometer registered 32° of frost on March 1st, while in Russia there were 12° of frost, with all the appearance of a still lower temperature.

The Coal Panic

of the present moment is nothing compared to the picture drawn by those pessimists who describe intense winters in the future and an exhausted coal supply. The question as to how long the British coalfields will last has often been asked, and has nearly as often been answered with more or less unreliability. The endurance assigned to them may be taken at an average of about 100 years. Without expecting much reliable information, some of the most recent estimates are worth looking at. Mr. Price Williams says that the coal in Nottinghamshire, Derbyshire, and Yorkshire will be exhausted in about 90 years; while the Midland Government Inspector of Mines says that in Nottinghamshire alone there are at least 500 square miles of coal not as yet sunk to. Taking what he considers to be the low estimate of 20 feet in thickness over the area, this would give 6,415,000,000 tons of coal, and would last for some hundreds of years after the exhaustion of the seams dealt with by Mr. Price Williams. It is moreover asserted that Yorkshire and Derbyshire are even better off. It is not likely that the coalfields will ever be absolutely exhausted, but it will be an evil day for England when the supply begins to fall off, and some authorities claim that there are even indications that this point has been already reached. In the immediate future we have, however, nothing to fear.

The Danger of Infection from Paper Money

that has been long in circulation was alluded to by us last week. A correspondent tells us that not long since he was so impressed with the danger that he took the advice of a doctor, which was published in several papers, in which he recommended the washing of notes with soap and water. This alarmist stated that he washed all the paper money he received before carrying it about and assured his friends that money so washed dried stiff and clean like new notes. Our correspondent tried the experiment and, although he was very lenient with both soap and water, and he did not give half the rubbing recommended, the notes were in such horrible condition when he had finished, that it took several weeks to get them changed into coin. If anyone has a desire to try this experiment we would strongly recommend him not to do it at all unless he can afford to stand out of his money for a week or two, or is within easy distance of a bank where he is known.

Newspaper Science

is the heading under which a contemporary—more technical than, but by no means equally accurate with SCIENCE SIFTINGS—is wont to disgorge its laboured comments upon the "errors" of the non-technical press. We cannot but admire the "gall" (to borrow an American colloquialism) that is exhibited in some of the comments we refer to. The utterances of dogmatic "authority," as it is assumed by our obscure electrical contemporary, are equally harmless and entertaining. When, however, the pedantry of the reviewer leads him to rail at scientific truth because expressed in simple language—when the generalisations of catholic philosophy are jeered at with the jealousy begotten of narrow specialism—there is much serious ground for censure. We deprecate, then, the over-confidence of any trade or technical organ which pretends on the authority of merely tentative conventions to set limits to the scope of those broader views of Nature which it is within the province of SCIENCE SIFTINGS to expound.

Much Ignorance

of technics is displayed by the average journalist, no doubt; and the strange words which constitute the shibboleth of science are rendered queerer still by reporter's blunders. Here then is a field in which our captious reviewer may revel to his heart's content. And we daresay that those trade writers, who have no more important matter wherewith to occupy themselves, may expend much vapidly vituperative energy upon the following excerpt. We cut it, for the amusement of our electrical readers, from a leading Sunday paper—to wit, *The People*.

"A Swindling Electrician."

Frederick William Mason, 22, electrician, was indicted for having obtained by false pretences from Sydney Sharp, a carsaw volt-meter, and a gravity animator, value £12; from the Planet and Electrical Engineering Company, three animators, and three volt-meters, value £13 10s. There were further indictments charging him with obtaining from Charles James Wharton, a galvometer and three animators, value £19 18s., also with obtaining the sum of £14 from Lieut. Dennis, R.A. In all there were ten different indictments against him."

BACK NUMBERS.

Any difficulty in obtaining back numbers of "Science Siftings" should be immediately notified to the Manager, "Science Siftings," 78, Fleet Street, London, E.C., who will give the matter his prompt attention.

GLEANINGS OF THE GLOBE.

THE volume of the moon, in our article "All about the Moon," was given incorrectly. The accurate figures are 5,298,700,000 cubic miles.

FOUR electric fans have been placed by the Crocker Wheeler Company in the turrets of the powerful iron vessel "Miantonomah," belonging to the United States Navy, the intention being that they shall blow away the smoke from the guns.

A RECENT medical work states that it "is a prejudice which depends upon self-deception to believe that a man becomes witty by aid of spirituous drinks. The error is one of the results of a paralytic influence. As the power of criticising oneself diminishes, self-complacency increases."

WHAT is the exact proportion of the waves of radiant electricity that would be reflected by a liquid electrolyte? This interesting question arises in connection with our article last week on "The Divining Rod," and we recommend it to the attention of our more scientific readers.

THE latest miniature photographic camera we have seen is the production of Messrs. Dollond and Co., of Ludgate-hill. It is so small that it only occupies a very trifling space in an ordinary sized purse; although the camera, when in use, extends to $3\frac{1}{4}$ inches. It is constructed to take pictures $1\frac{1}{2}$ inches square. The purse alone appears worth the 6s. asked for the entire apparatus.

A TYPE-WRITER, modelled on an entirely new principle, will shortly be placed on the market by Mr. J. N. Maskelyne, of Egyptian Hall fame. No ink ribbon will be required for the machine, which is almost noiseless in operation, and the characters are visible to the operator the moment they are printed. The new machine is sure to receive a hearty welcome.

ON Mount Washington, in New Hampshire, lives a little colony of butterflies that never descends below 2,000 feet from the summit. They are completely isolated from others of their kind, butterflies being found in no other spot in their immediate vicinity. It is supposed that the remote ancestors of this curious race were stranded on the mountain at the close of the glacial period.

RECOVERIES from colour-blindness are not unknown. There is an engine-driver in Russia whose sight was perfect in 1889. In that year he lost all power to distinguish colours. Everything appeared to him to be red. In 1890 the man declared that his sense of colour had been suddenly restored. This proved to be the fact, and the case is regarded by the *Lancet* as showing that sensation of colour is perfectly independent of the physiological function.

OCCASIONALLY the firefly of the West Indies—the cucujo, an inch-long beetle is brought to this country as a curiosity, and if fed on sugarcane and kept in a moist atmosphere it can be preseved in health for several weeks. The people of the Caribbean Islands use these beetles for ornament, confined in folds of gauze, where the beautiful green light which they emit—their red light flashes only in flying—is more varied and splendid than any emerald that ever shone in the crown of a king. A number of these insects together under glass is said to give sufficient light for dressing or reading without producing any heat.

INFLAMMATION of the brain of the severest kind, caused through blows on the head, can now be cured, it is claimed, by lubricating all the internal membranes of the nose with glycerine. This causes water to descend by the nose and throat so abundantly that the brain is thereby relieved, and headache removed. This discovery is due to Mr. James Johnstone, 8, Merchiston Park, Edinburgh, who has issued a small pamphlet containing details of this cure, and the result from it, entitled "The Action of Glycerine on the Brain."

A DEPOSIT of natural paint (96 per cent. oxide of iron) has been discovered 20 miles from Newcastle, Northumberland County, New Brunswick. The paint is so pure that it does not require refining, or even manufacture, since it is ready for mixing with oil in the proportion of two pounds of paint to a gallon of oil. America appears to be a happy land where all the necessities of life are to be found growing on the hedges. Our cousins will next discover butter trees, and pigs ready roasted, running about with knives and forks stuck in their backs.

WHEN Sheffield first became famous for its cutlery, a peculiar-shaped knife, designed for a variety of uses, was made with great care and sent to the agent of the Cutler's Co. in London. On one of the blades was engraved the following challenge:

London, for thy life.
Show me such another knife.

The London cutlers, to show that they were equal to their Sheffield brothers, made a knife, with a single well-tempered blade, the blade having a cavity containing a rye straw $2\frac{1}{2}$ inches in length, wholly surrounded by the steel; yet, notwithstanding the fact that the blade was well tempered, the straw was not burned, singed, or charred in the least. It is needless to add that the Sheffield cutlers acknowledged themselves outdone in ingenuity.

A REMARKABLE example of rivers flowing inland is found in Africa. Near the shores of the Gulf of Aden is a small body of salt water, Lake Assal, occupying a basin whose flow is several hundred feet below sea level. The surface of the lake itself is nearly 700 feet below mean tide, and it is fed by a stream some twenty or more miles in length flowing from the ocean. It is highly probable that the whole basin which the lagoon partly fills was once an arm of the sea, which became separated therefrom by the drifting of loose sand. The inflowing river, which is, of course, nothing but the remnant of a tidal estuary, has a limited volume, and it has filled the basin to the extent that evaporation and supply exactly balance each other. It is evident that Lake Assal, like the Kara bog has, is destined to become a salt bed.

A CURIOUS scientific toy was recently exhibited at a meeting of the Royal Society. It is a heat engine, based upon the principle that nickel, magnetic at ordinary temperatures, promptly becomes non-magnetic at a temperature of 572° F. The construction of the engine is as follows:—A disc of copper is suspended by two strings so that it can swing like a pendulum. Mounted on the copper disc is a magnet which holds up a piece of nickel. An alcohol lamp, placed below the disc, heats the nickel until it becomes demagnetised and drops away, when the copper pendulum makes an oscillation. During this oscillation the nickel cools sufficiently to regain its magnetic character, and is caught up by the swinging magnet only to be passed again over the lamp, which causes it again to drop, and so on, the pendulum being thus kept in motion.

SCIENCE QUERIES AND ANSWERS.

A prize of two shillings and sixpence will be awarded for every interesting question asked by our readers and published in this column, and five shillings will be given for every answer published. In all cases when a similar question or reply is sent in by two or more correspondents, the award will be given to the one whose letter is first opened, provided the subject is properly treated. Questions asked by correspondents and not replied to by our readers, may, if of sufficient interest, be dealt with Editorially.

Rules for Competitors.—(1) Only one question may be sent each week, but any number may be answered. (2) Write on one side of the paper only. (3) Envelopes must be marked "Science Queries and Answers," and must arrive not later than the Monday following date of publication.

The following are Answers to Queries published in No. 20.

43.—What is the size of the red blood corpuscles? How many are contained in, say a cubic inch; and how is this number determined?

The red corpuscles in blood are about $\frac{1}{3200}$ inch diameter, and $\frac{1}{12700}$ inch thick. They are in the form of biconcave discs, of which there are over eighty thousand millions in a cubic inch of blood. To determine the number of corpuscles, blood is diluted with say 100 vols. of sulphate of soda solution (sp. gr. 1·025). In this condition the corpuscles can be readily distinguished and counted with the aid of a microscope.

44.—What is the maximum power of human muscle?

In the case of the flexors of the arm and leg, this force is respectively 95 and 110 lbs. per square inch, sectional area, of muscle. Taking the case of the flexor of the arm as the most interesting, if not the most important muscle, we may calculate the maximum power of the elementary fibres as follows: There are about 798,000 muscular fibres, each of, say 3-millionths of a square inch sectional area. As the total sectional area is 2·4 square inches, it follows that the power exerted by each fibre is upon the average 2 grains.

45.—Is there any method of photographic printing that avoids the use of poisonous chemicals?

Yes, there are several such methods. Perhaps the simplest depends upon the bleaching action of sunlight on many pigments of vegetable origin. The red juice obtained by maceration of common red poppy flowers in alcohol assumes a delicate blue colour after painting on paper and drying. If this paper be exposed to sunlight under a transparent positive, the result is a very pretty, although of course, fugitive picture. If the minute amount of poisonous matter existant in poppy flowers be objected to, we may replace them by wallflowers, stocks, marigolds, or violets; all of which, under similar treatment, are capable of yielding interesting prints of varied colours.

46.—What is the relative luminosity of sun, moon, and stars, in clear weather?

The sun, having a temperature of probably 10,000° C, lights the earth with an intensity equal to that of about 5,500 candles placed at a distance of one foot. The light of the full moon being only equal in intensity to that of one candle, at a distance of twelve feet, it follows that the apparent luminosities of sun and moon are relatively as 800,000 to 1. The intensity of starlight is estimated at one-sixtieth of that of the moon; or, in other words, as equal to that of one candle placed at a distance of 93 feet. It may be of interest to remark that any substance at the focus of a burning glass is virtually carried up almost to that point in space at which the angular diameter of the sun is equal to that of the burning glass. Hence a button of carbon or lime in vacuo, at the focus of a sufficiently large mirror or lens, is brought by condensation of the sun's rays to a condition of brilliant incandescence.

47.—What is the simplest astronomical proof and illustration of the laws of gravity?

The case of the moon affords the simplest illustration. Approximately, this body would move in a straight line, except for gravitational force urging it towards the centre of gravity of the earth. Since we know that the moon is distant from us by about 60 earth radii, and that its mass is about one seventieth of that of the earth, it is an easy matter to estimate very closely the rate at which it falls towards the earth in each second in obedience to the well-known laws of gravity, that is, in other words, the extent to which the line in which it moves is curved.

48.—At what rate is work done by the involuntary motion of the heart, as compared with that done by machinery?

At the rate of about 187 foot lbs. per minute. That is, about $\frac{1}{176}$ h.-p. This figure is arrived at as follows:—The capacity of the left ventricle of the heart is about 3 ounces of blood, that of the right is about 1 ounce. These 4 ounces ($\frac{1}{4}$ lb.) being projected through the arteries at each pulsation with a force equivalent to 10 feet hydrostatic pressure, the power exerted may be expressed as $2\frac{1}{2}$ ft. lbs., and it is only necessary that this should be multiplied by the number of beats per minute— that is, as a rule, by 75.

QUERIES.

Replies to the following Queries must reach the Office by Monday at latest; and those selected will be published in the issue after next.

55.—What is the fastest motion that can be given to a mass of matter by artificial means?

56.—What is the chemical constitution of the brain?

57.—How can eclipses of the moon be predicted, without the aid of elaborate calculations or the nautical almanack?

58.—What causes the ruddy colour of a sunset?

59.—What was the first application of instruments to the purpose of astronomical observation?

60.—In what way can the colourless serum be separated from fresh blood, and what physical characteristics does it present?

LIGHT FOR PHOTOGRAPHERS.

It frequently happens that during photographic excursions, the professional or amateur student meets with some interesting scene which he would like to photograph, were he not prevented by the bad light. He determines to return at a more favourable time when the light is in a better condition; but the great difficulty is to find out this particular time. There is a very easy method for doing so with the aid of a watch, provided you know at what point of the compass you are situated. You hold the watch horizontally, turning the figure XII. to the north, then letting fall—in imagination of course—a straight line starting from the point to be photographed, and falling on the centre of the dial, this straight line cuts exactly the hour when the object will be under a good light. Evidently the weak point in this method is that for its application you must know the north; but we know how easy it is to find out your position, either with a small compass (although the polarity of the needle is influenced by numerous variations) or by observing the side on which the moss grows on the trunks of trees, rocks, etc. However it may be, the method is fairly practical and economical and likely to be very serviceable in many cases.

THE GREGORIAN CALENDAR.

There is quite an interesting matter which the present leap year brings before us. This is a consideration of the perfect arrangement of our calendar, by which the civil and solar years are made so exactly to correspond that 4,000 years from now, with our present system of computation, the civil 1st of January will be at exactly the same distance in point of time from the vernal equinox that it is to-day.

This was not always so; indeed before the days of Julius Cæsar, frightful confusion prevailed, the individual in power changing the length of years to suit his own election arrangements, or any other personal convenience, with the utmost arbitrariness, intercalating as many days and even months as he fancied in order to suit his own political ends.

By the time of Julius Cæsar matters had reached such an unexampled state of abuse and confusion that he sought the assistance of Sosogines, a Greek astronomer, to reduce them to order.

Julius Cæsar abolished the lunar year and intercalary month, and regulated the civil year entirely by the sun. Sosogines found that by taking any point on the ecliptic as a starting point it takes the sun 365 days, 5 hours, 48 minutes and 46 seconds, mean solar time, to return to that point again. Hence all years cannot contain the same number of days if the epoch of commencement remains fixed, for the day and the civil year must begin at the same instant. Therefore Julius Cæsar decreed that every fourth year should contain 366 days; other years 365.

In order to restore the vernal equinox to the time it occupied in the days of Numa—namely, March 25—he ordered two extraordinary months to be inserted between November and December of the current year. These, with the intercalary month, made ninety extra days added to the ancient year, which gave that year 445 days. It was known as the last year of confusion. The first Julian year was January 1st, 46 B.C.

The people of the time of Julius Cæsar enjoyed a much more simple and sensible division of the year into months than our present unreasonable system. He ordered that the first, third, fifth, seventh, ninth, and eleventh months should contain thirty-one days. All the others thirty, except February, which should have twenty-nine, save on leap year, when it, too, should have thirty; a nice plan and very easy to remember. But when Augustus became Emperor his vanity was such that he could not brook the idea of July, the month named for Julius, containing more days than August, the month named for himself. So he took a day from poor little February and added it to his month. By thus bringing three months of thirty-one days together he changed the order of the entire latter half of the year, giving the even numbered months thirty-one days and reducing the odd months to thirty. And thus it has continued to the present time; so through the despicable vanity of one man we have our present cumbrous arrangement.

Although the Julian intercalation is the most convenient that could be adopted, it yet makes the year eleven minutes and fourteen seconds faster than the sun; which error, slight as it is, amounts to a day in 128 years. So, in the course of a few centuries, it was found that the vernal equinox had sensibly retrograded toward the beginning of the year. In 1582 Pope Gregory XIII, corrected the calendar by omitting ten days, and making the rule that every year of which the number is divisible by four without a remainder (as, for instance, 1892) is leap year, except centurial years, which are only leap years when the two left-hand numbers are divisible by four. Thus 1,600 and 2,000 are leap years, while 1700, 1800, and 1900 are not. So it behoves all maidens who think of taking advantage of the privilege of leap year to profit by the opportunities of this year and 1896, for there will not be another chance till 1904.

The Gregorian intercalation is so perfect that the sun only loses twenty-six seconds a year; which would only amount to a day in 3,323 years. Even this slight error is corrected by making the year 4000 and all its multiples common years.

All Christian countries, except Russia, have adopted the Gregorian calendar. Spain, Portugal, and a part of Italy adopted it the same day as Rome; France in December of the same year; the Protestant States of Germany, Denmark, and Sweden in 1700; Scotland in 1600; Great Britain conservatively clung to the old style till 1751, and, strange to say, Russia adheres to the obsolete form to this day.

THE CAUSE OF TRADE WINDS.

The effect of the sun's rays is at a maximum in the equatorial regions, where they fall nearly vertically upon the earth throughout the year. Here the air is constantly heated to a higher degree than elsewhere, and here it constantly ascends, drawing in the adjoining air from the colder regions north and south in two great surface currents. The impulse of this draught is felt 2,000 miles away; and across all the intervening distance, the trade winds sweep toward the belt of calms. If the draught created by the upward flow near the equator were the only force involved, the winds would blow from north and south instead of from north-east and south-east. But the whole atmosphere is in revolution with the earth from west to east; and at any given point, with the velocity of the earth at that point. This velocity, in any latitude north or south, is less than at the equator, since the circumference of the earth is less, and therefore the distance through which a point on its surface passes in a given time. Thus, while a point at the equator moves through 24,000 miles in a day, a point on a parallel of 60 degrees moves through only half that distance. The trade winds begin at about the thirtieth parallel of latitude. At the instant where a particle of air in this latitude yields to the impulse that draws it toward the equator, it is already in motion to the eastward, but with a velocity less than that of any part of the earth's surface over which it has to pass in its journey to the belt of calms. Hence, as it moves south or north toward this belt it is constantly lagging behind. The earth whirls past beneath it to the eastward, giving to the air an apparent motion to the west. The effect of this feature is less marked as the equator is approached, because here the parallels are more nearly of the same length. Thus, at the end of their course the trades blow nearly due north and south; and where they meet, neutralise each other, producing the belt of calms that has been referred to. This belt has an average breadth of six degrees of latitude, but it is so variable that at times it seems to be wiped out entirely. It is not unusual for a ship that has lain becalmed there for days to see another coming up to her with every sail filled by the trade wind, which now suddenly sweeps across until it actually mingles with the opposite trade, the shift from one to the other coming almost instantaneously in a violent but short-lived squall. Nor is the calm belt constant in position. It changes with the changing seasons, sweeping north and south with the sun, and carrying the whole trade wind system with it.

It is claimed that eight men die suddenly to one such death among women.

THE WONDERS OF A DEAD WORLD.

We incidentally referred in our last issue to the wonderful finds of fossil remains that are being made in America. There is one gigantic lot now awaiting to be transported from Newhaven, Conn., to Washington. It contains monstrous reptiles as big as good sized houses, some of them 100 feet in length, flying dragons with a 25 foot spread of wings, huge birds with teeth, mammals two or three times as big as elephants, sharks as large as the hugest whales, other fishes clad in mighty plates of armour, and countless specimens more, of equal strangeness and enormous dimensions, such as actually inhabited the world in prehistoric times. For nine years past the United States Government has been digging up and putting together the skeletons of these strange creatures, and now the vast collection is preparing for shipment by rail to the National Museum.

The business of digging for these tremendous fossils is carried on pretty much like any other mining. In various parts of the West there are great deposits of them, into which the scientific enthusiasts eagerly delve for relics of epochs thousands of centuries old. One of their chosen hunting grounds is the region between the Rockies and the Wasatch Mountains. Ages ago the upheaval of these hills by geologic action cut off the portion of what had been sea between these ranges from the ocean, and the water thus shut away formed many big lakes. A typical one of this sort existed in Wyoming, and around it the mighty antediluvian mammals gathered in herds to crop the succulent and luxuriant vegetation of what was then a tropical climate in that region. They died natural deaths or became mired in the mud when they went to drink, and the sediment slowly deposited in the water covered up their bones and preserved them from decay. This sediment reached a mile in thickness, holding between its layers the ancient skeletons, distributed like currants through a cake. At length the water draining off, left the land dry, and, in the case of the Wyoming lake referred to, subsequent floods washed away much of the sediment previously deposited, leaving what are now called "bad lands"—picturesque with cliffs, peaks, and columns, carved out in fantastic shapes and of variegated colouring.

Through such a region as this the scientific explorer travels with his eyes wide open for fossils. If from the face of some rocky cliff he chances to see a bone project, exposed by the action of water that has cut away the hillside, he sets a party of men to quarrying with drill, blast, and pickaxe, until whatever is there in the way of remains has been taken out. Possibly some great deposit of prehistoric monsters may be struck in this way, in which case the find is kept as secret as possible, being regarded by the discoverer as his private mine. If he gave it away, rival palætiologists would rush to the spot and dig out all the animals for their own study and glory. Professor O. C. Marsh, who directed the gathering of the Government collection referred to, has such mines of his own all over the West, from which he can draw to order the most astonishing variety of gigantic creatures. He made the remark the other day that there was one small valley he knew of, where relics of the ancient mosasaurus were so plentiful that, passing through it recently, he noticed skeletons of six of these mighty swimming lizards, each eighty feet in length, in sight at one time.

Usually these amazing fossils are found embedded in solid rock. After they have been roughly quarried out, the sandstone or other matrix inclosing them is carefully chiseled away from the bones. The latter receive a coat of glue to keep out the decomposing air, and any that are broken or splintered are bound up with twine, after which they are packed for shipment. When one of these beasts of antiquity died, its carcase being covered up with sediment that afterwards became stone, the skeleton was apt to be preserved entire and with its parts in position, already for mounting in a museum. A new reptile was found in Wyoming the other day in such a complete state, which has been named brontosaurus. It was 60 feet long, stood 15 feet high when alive, and weighed 20 tons. Cast in the rock from which it was taken was a perfect mould of one of its eyeballs, with which it looked upon the world three millions of years ago. It had a very small head, a long and flexible neck, a short body, and a huge tail. In the same neighbourhood also has been discovered recently another reptilian monster called the triceratops, which had an enormous bony frill around the back of its neck. This surprising development, measuring six feet across, was intended for the attachment of great muscles that were necessary for holding up the huge head. The animal, though tremendously massive, was only thirty feet long; but it was covered with plates of armour and had a sharp and horny beak, not to mention a horn on its nose and another on its forehead, the latter 2½ feet in length.

In Colorado have been found great deposits of the bones of titanosaurs, the biggest land animals that ever existed. They grew to be 65 feet long and stood 40 feet high when erect upon their hind legs. Instead of browsing, as did the brontosaurus and triceratops, upon the luxuriant aquatic vegetation around the lake borders, they fed upon the foliage of trees on the mountain sides. Likewise did the iguanodon, several times as heavy as an elephant, which had a nipping beak like a turtle's and also walked erect, using its huge tail for a support, and towering to the height of 40 or 50 feet.

In the mesozoic epoch, or "Age of Reptiles," when those creatures lived, these and other herbivorous animals were the biggest of the beasts. One of them, the atlantosaurus, was 100 feet long, its thigh bones, many of which have been found, measuring eight feet in length and twenty-five inches through. They had various methods of pursuing existence. Some went on all fours and had backbones that were mere shells filled with warm air from their lungs, which served them as floats while they walked in the sea shallows in water deep enough to cover their backs, extending their long necks to crop the vegetation alongshore. Of this sort was the camerasaurus, eighty feet in length. Others had enormously long hind legs, on which they were able to wade out far into the ocean after seaweeds, and were provided with not fewer than 2,000 teeth for grinding their food. Such was the mighty kangaroo-like hydrosaurus. Yet other species dwelt on land, like the triceratops, and these were provided usually with armour and horns for defence.

It would seem as if such monsters as are described need have feared no living foes, but in fact they were a common prey to great numbers of frightful carnivorous reptiles, smaller in size, but of tremendous activity and fierceness, which fed upon these unwieldy, vegetable-eating giants. Most terrific of all, perhaps, was the incredibly ferocious lælaps, which was forty feet long, stood twenty-five feet high on its hind legs, and was built like a kangaroo. It was the most astonishing jumper that ever existed, with teeth for cutting, and sharp claws on the front feet, evidently designed for tearing out the eyes of victims or adversaries. Hardly less formidable, and equally large, was the stagosaurus, which was sheathed in armour plate from two to three feet wide, and employed as a weapon of offence its powerful tail, armed near the end on both sides with sharp spikes two feet long. This animal walked erect also, and one of its peculiarities

was a great enlargement of the spinal cord at the lower end of the back. In fact, the expansion of brain material, intended to provide for the wagging of the mighty spiked tail, was ten times as big as the brain in the skull itself. Equally large and dangerous were the megalosaurus and the dinosaurus, their jaws armed with huge sabre-like teeth, which went about on their hind legs looking for something to devour. Against such fearful foes what chance had the peaceful cetoisaurus and elasmosaurus, dwelling in marshes and shallows, with the bulk of six or eight elephants? Nevertheless, some of herbivorous land reptiles referred to, like the gigantic horned and armoured agathumus, could make a good fight with the carnivora, and were so well able to defend themselves that they lived and multiplied in the same region with the latter. But most of these vegetable feeders had no other means of defence than kicking, which they could do with some effectiveness with hind legs fifteen feet or so in length.

Of course, these represent but a few of the countless species of giant beasts that roamed over the earth in droves during the vanished epoch. That was the age when reptiles ruled creation. They walked upon land, swam the seas, flew through the air, climbed trees, and did everything that mammals do nowadays. There were bird reptiles and reptilian birds. Some had wings for flying with a spread of twenty-five feet—veritable dragons, in fact. Others, forty feet in length, had paddles for swimming like a whale's. These latter lived in the seas, though occasionally they came on shore. It is known from their petrified excreta, which are plentifully found to-day, that they lived upon fish. One species dived to great depths in the ocean, and was most rapacious and predatory. It had enormous eyes to see with in deep water, its head resembling an alligator's. Another kind, with a very long neck, inhabitated the shoals and preyed upon the fishes of the shallows. The first serpents, too, belonged in the sea, and grew to be forty feet long. They had no poison, but were constrictors, like the boa. There were many kinds of crocodiles fifty feet from snout to tail, whereas the biggest ones now are not more than fifteen feet. During the same period lived the birds with teeth, which were only discovered a few years ago. Biggest of these was the hesperornis, which stood six feet high, and had only rudimentary wings. It did not fly, therefore, but was simply a swimmer and diver, subsisting on fish. The ichthyornis was somewhat similar in appearance and habits, but not much larger than a pigeon. It is supposed that these strange water fowl were wiped out by the giant swimming lizards, eighty feet long, and clad in bony armour plates, which resembled the modern conception of the sea serpent. The turtles should not be forgotten, which attained a length of twenty feet, and measured seven feet in height.

It is not only the age of reptiles, however, that is represented by the unparalleled collection described. Before that came the epoch of fishes, when they ruled the world and had all creation pretty much to themselves. Of this era, likewise, the United States Government has gathered together a vast quantity of fossil relics. The face of the earth did not look then at all as it appears now. Most of what are now called the continents had not been upheaved above the ocean; nearly everywhere was sea, with comparatively small land masses elevated out of it. The atmosphere was hot, moist, and loaded with carbonic acid, so as to be unbreathable. In the waters swam enormous armoured fish, such as the dinichthys, which was twenty feet long, and had such tremendous jaws and teeth, that it could have bitten a man in two as easily as a man could a radish. Later on came sharks of the fiercest type, which must have been as much as seventy feet in length at least. The biggest tooth of a man-eater of to-day is about an inch long, while the teeth of these ancient sharks, found in enormous numbers, measure more than six inches. That was the golden age of the scaly tribe.

The giant reptiles that appeared on the scene in the subsequent epoch were remarkable for the smallness of their brain cavities. In some of them the brain was so small that it could have passed without injury through all the vertebræ of the spinal column down as far as the beginning of the tail. All of them were wiped out of existence by the great cataclysm which upheaved the Rocky Mountains, the Alps, and Himalayas, and brought to a close the mesozoic epoch. Then came the age of mammals, at the end of which we are now, man being the last arrival on the scene.

The age of monsters pretty nearly has passed away, only a few remaining, like the elephant and the whale. Small animals with plenty of sense will always survive stupid giants in the long run, because they require less food and know better how to avoid danger. Observe in illustration how the doom of extinction has fallen upon the gigantic mammals which roamed over the earth by myriads only so short a time ago, comparatively speaking, as the beginning of the present era, called the cenozoic. There was the dinaceras, which lived in herds about the lakes, as the deposits show, big as an elephant, but in appearance somewhere between the rhinoceros and the hippopotamus, with three pairs of horns on its head and huge sabre-like tusks that fitted into sheaths in the lower jaw. More imposing yet was the tinoceras, somewhat similar of aspect and sixteen feet long. Not less impressive was the megatherium or giant sloth, as large as two elephants, and which attained a measurement of eighteen feet, and procured the leaves on which it fed by seating itself upon its mighty haunches and uprooting great trees. Of the dinotherium, no complete skeleton has been discovered, but it was, doubtless, the biggest land mammal that ever lived. A full grown skull of this earliest of proboscidians, which had long tusks as well as trunk, measures five feet from the point of the lower teeth to the top of the head. The brontops, of elephantine size, had a head like a rhinoceros, with huge horns. Quite as remarkable was the sivathorium, a beast like an antelope, big as an elephant, with two conical horns on the front of its head and two immense spreading ones behind. Among birds were waders ten feet in height, such as the dinornis and gastornis. Contemporary with them were the mammoth and the mastodon, the woolly rhinoceros, armadillos nine feet in length, and the sabre-toothed tiger, larger than the greatest lion of to-day.

SIFTINGS OF THE STUDY.

The Art of Photographing Microscopic Objects.

(W. Tylar, Birmingham.)

To those of our readers taking up the absorbingly interesting work of photo-micrography, we can confidently recommend this little treatise. It is clearly and concisely written, and will prove of much use to the beginner. It is sent post free for twopence.

The largest known roof on a permanent structure is said to be that of the Midland Railway Station, St. Pancras. It was opened for traffic in 1868. Its total length is 690 feet, its breadth 245 feet 6 inches.

THE MECHANISM OF THOUGHT.

The old Hebrew necromancers were said to obtain oracles by means of teraphim. A teraph was the decapitated head of a child, placed on a pillar, and compelled by magic to reply to the questions of the sorcerer. Let us suppose, for the sake of illustration, that the legends of such enchantments rest on some groundwork of fact, and that it might be possible, by galvanism or similar agency, to make a human corpse speak, as a dead sheep may be made to bleat. Further, let us suppose that the teraph only responded to inquiries regarding facts known to the owner of the head while living, and therefore, impressed in some manner upon the brain to be operated on. In such a teraph we should possess a fair representation of the mental part of human nature, as it is understood by a school of thinkers, considerably in past ages, but especially so at present. The brain itself, according to this doctrine — the white and grey matter, such as we see and touch it, irrespective of any imaginary entity beside— performs the functions of thought and memory. To go beyond this all-sufficient brain, and assume that our conscious selves are distinct from it, and somewhat else beside the sum-total of its action, is to indulge an hypothesis unsupported by a tittle of scientific evidence. Needless to add, the still further assumption that the conscious self may possibly survive the dissolution of the brain, is absolutely unwarrantable.

It is our hope to show that, should physiology establish the fact that the brain, by its automatic action, performs all the functions which we have been wont to attribute to "mind," that great discovery will stand alone, and will not determine, as supposed, the further steps of the argument, namely, that our conscious selves are nothing more than the sum of the action of our brain during life, and there is no room to hope that they may survive their dissolution. We hope to show not only that these conclusions do not necessarily flow from the premises, but that, accepting the premises, we may logically arrive at opposite conclusions. We hope to deduce, from the study of one class of cerebral phenomena, a presumption of the separability of the conscious self from the thinking brain, and thus, while admitting that "thought may be a function of matter," demonstrate that the self in each of us in not identifiable with that, which, for the want of a better word, we call "matter." The immeasurable difference between such a remembering, lip-moving teraph as we have supposed and a conscious man, indicates the gulf leaped over by those who conclude that, *if* the brain can be proved to think, the case is closed against believers in the spirituality and immortality of our race. In brief, it is our aim to draw from such an easy and every-day psychological study as may be verified by every reader for himself, an argument for belief in the entire separability of the conscious self from its thinking organ—the physical brain. Whether we choose still to call the one "spirit" and the other "matter," or to confess that the definitions which our fathers gave to those terms have ceased to be valid in the light of modern science—that "matter" means only "a form of force," and that "spirit" is merely an unmeaning term for an unknown thing —this verbal controversy will not in any way effect the drift of our argument. What we *need* to know is this : Can we face the real or supposed tendency of science to prove that "thought is a function of matter," and yet logically retain faith in personal immortality ? We maintain that we may accept that doctrine and draw from it an indirect presumption of immortality, afforded by the proof that the conscious self is not identifiable with that matter which performs the functions of thought, and of whose dissolution alone we have cognisance.

Our first task must be to describe the psychological facts from which our conclusions are to be drawn, and which seem in themselves sufficiently curious and interesting to deserve more study on their own account than they have yet received. Secondly, we shall simply quote Dr. Carpenter's physiological explanation of these facts. Lastly, we shall, as shortly as possible, endeavour to deduce from them that which appears to us to be their logical inference.

The phenomena with which we are concerned have been often referred to by metaphysicians—Leibnitz and Sir W. Hamilton among others—under the names of "latent thought" and "preconscious activity of the soul." Dr. Carpenter, who has discovered the physiological explanation of them, and reduced them to harmony with other phenomena of the nervous system, has given to them the title of "unconscious cerebration," although even he considers the term slightly contradictory, and to this name we shall adhere.

It is an every-day occurrence to most of us to forget a particular word, or a line of poetry, and remember it some hours later, when we have ceased consciously to seek for it. We try, perhaps anxiously, at first sight to recover it, well aware that it lies somewhere hidden in our memory, but unable to seize it. As the saying is, we "ransack our brains for it," but, failing to find it, we at last turn our attention to other matters. By-and-bye, when, as far as consciousness goes, our whole minds are absorbed in a different topic, we exclaim, "Eureka!" The word or verse is so and so. So familiar is this phenomenon that we are accustomed in similar straits to say, "Never mind ; I shall think of it by-and-bye." And we deliberately turn away, not intending finally to abandon the pursuit, but precisely as if we were possessed of an obedient secretary or librarian, whom we could order to hunt up a missing document, or turn up a word in a dictionary, while we interested ourselves with something else. The more this common phenomenon is studied, the more the observer of his own mental processes will be obliged to concede that, so far as his own conscious self is concerned, the research is made absolutely without him. He has neither pain nor pleasure nor sense of labour in the task, any more than if it was performed by somebody else; his conscious self is all the time suffering, enjoying, or labouring on totally different grounds.

Another and more important phase of unconscious cerebration is that wherein we find our mental work of any kind—a calculation, an essay, a tale, a composition of music, painting, or sculpture—arrange itself in order during an interval, either of sleep or wakefulness, in which we had not consciously thought of it at all. Probably no one has ever written on a subject a little complicated, or otherwise endeavoured to think out a matter any way obscure, without perceiving next day that the thing has somehow taken a new form in his mind since he laid down his pen or his pencil after his first effort. It is as if a fairy had come in the night and unravelled the tangled skeins of thought and laid them all neatly out on his table. We have said that this work is done for us either asleep or awake, but it seems to be accomplished more perfectly in the former state, when our unconsciousness of it is more complete.

Again, there is the ordinary but most mysterious faculty possessed by most persons of setting over night a mental alarm clock, and awaking at will at any unaccustomed hour out of a dreamless sleep. Were we up and about our usual business all night, without seeing or hearing a timepiece, or looking out at the stars or the dawn, few of us could guess

within two or three hours of the time. Or, again, if we were asleep or dreaming, with no intention of rising at a particular time, the lapse of hours would be unknown to us. The count of time in dreams is altogether different from that of our waking life, and we dream in a few seconds what seem to be the events of years. Nevertheless, under the conditions mentioned, of a sleep prefaced by a resolution to waken at a specified hour, we arrive at a knowledge of time unattainable to us either when awake or when sleeping without such prior resolution.

Such are some of the more striking instances of unconscious cerebration. But the same power is obviously at work during, at least, half our lives, in a way which attracts no attention, only because it is so common. We read aloud, taking in the appearance and proper sound of each word and the punctuation of each sentence, and all the time we are not thinking of these matters, but of the argument of the author, or picturing the scene he describes, or, possibly, following a wholly different train of thought. Similarly, in writing, it would almost seem that the pen itself took the business of forming the letters and dipping itself in the ink at proper intervals, so ingrossed are we in the thoughts which we are trying to express. We unconsciously cerebrate —while we are all the time consciously buried in our subject —that it will not do to begin two consecutive sentences in the same way; that we must introduce a query here, or an ejaculation there, and close our paragraphs with a sonorous word and not with a preposition. All this we do not do of *malice prepense*, but because the well-tutored sprite, whose business is to look after our p's and q's, settles it for us, much as a clerk does the formal part of a merchant's correspondence.

Piano-playing, however, is, of all others, the most extraordinary manifestation of the powers of unconscious cerebration. Here we seem to have not one slave, but a dozen, Two different lines of hieroglyphics have to be read at once. and the right hand is to be guided to attend to one of them, the left the other. All the ten fingers have their work assigned as quickly as they can move. The mind interprets scores of A sharps, and B flats, and C naturals, into black ivory keys and white ones; crochets, and quavers, and demisemiquavers, rests, and all the other mysteries of music. The feet are not idle, but have something to do with the pedals: and, if the instrument be a double-actioned harp, a task of pushings and pullings more difficult than that of the hands. And all the time the performer—the *conscious* performer—is in a seventh heaven of artistic rapture at the results of all this tremendous business, or, perchance, lost in a flirtation with the individual who turns the leaves of the music-book.

(*To be concluded next week.*)

WONDERFUL BABIES.

The year 1769 was the "year of great babies." At one date or another in that year were born Napoleon, the Duke of Wellington, Marshal Ney, Marshal Soult, Borrienne, the secretary and biographer of the Emperor; Brunel, the engineer of the Thames Tunnel; Chateaubriand; De Witt Clinton, of New York; Francois Accum, the chemist; Bessieres, one of Napoleon's best officers; Cuvier, the naturalist; Admiral Sir Thomas Hardy, Alexander Humboldt, Count Lavalette, the diplomatist; Judge Lowell, the founder of the Boston Athenæum; Mehemet Ali, Pasha of Egypt; William Owen; Picard, the French dramatist; Lord Castlereagh, Tallien, and many others distinguished in various lines of life.

OBJECTS FOR THE MICROSCOPE.

To the amateur microscopist it must often occur to exhibit the power of his instrument to friends who are not familiar with it. On such occasions the selection of unsatisfactory objects is most disappointing. The foot of the common house fly, although a wonderful structure, has been described so often in juvenile literature that the audience is apt to yawn over an explanation of claws and suction disc. So with the circulation of blood in the frog's foot, the rabbit's ear, and the salamander's tail. So with the irrational motions of amœbæ in river water.

It is the unpretentious object of this item to enumerate some other readily obtainable objects for extemporaneous use on such occasions. They require no elaborate preparation and no re-agents.

The feathery dust from the wing of the "dusty miller" is, perhaps, too commonly used to need mention. The feet, eyes, antennæ, and wings of cockroaches, bees, wasps, mosquitoes, and butterflies furnish a great variety of wonder-inspiring views.

Often you will be compelled to disappoint someone who expects to see "lots of little squirming things" in a drop of well water, but a drop of slime from the under surface of a lily pad will fully meet such expectation.

The tail of the newt still remains the most convenient object for showing the circulation of blood. In the same jar where the newts are kept a few sprigs of chara should be kept growing. The stem of chara shows cyclosis beautifully. Thin peelings from the bulb of the common onion also show sap circulation well. In cold weather the onion should be kept in a warm place a few hours to quicken the circulation of the sap.

Cross sections of common woods make interesting specimens. They can be cut with a keen jack knife, if one has the "knack." A shoot $\frac{1}{4}$ inch in diameter, makes a good specimen to begin on, and any soft wood will answer.

Stellate and glandular hairs of plants, the breathing pores of such plants as the white lily, the translucent leaves of mosses, and the pollen of flowers should not be forgotten.

Minute seeds, with their infinite variety of form and marking, are things of beauty and a joy for ever. They require a condenser, but no cover glass. Try the seeds of Arenaria serpyllifolia, and you will be encouraged to seek further. A most delightful series of objects can be easily made from the small seeds of Caryophyllaceæ. The genus Euphorbia furnishes another fine series in which you can often determine the species by the seeds alone. Juncus gives us still another series. In J. effusns and J. bufonius the ribs and cross lines of the seeds are delicate indeed.

The pappus of many species of compositæ is a charming sight under the microscope, especially when the pappus is plumose, as in kuhnia, the thistles, etc.

Most of the common grasses have plumose stigmas, which, with their colouring of purple, show finely with objectives of moderate power. The hairy palets of grasses make first-class objects.

Lycopodium, the powder which druggists use to keep pills, etc., from sticking together, will prove of interest and is easy to obtain. It consists of the spores of the common club moss or evergreen. The spores move over each other so freely that the powder in bulk shakes like a liquid. To the touch it seems like an oily liquid. But under the microscope it appears as innumerable yellow globes, somewhat shrunken and irregular when dry. Any species of lycopodium will furnish a supply from August to October. The spores of ferns and mosses are equally interesting.

But if you wish to elicit from your audience exclamations of delight, put on the slide a freshly ruptured spore case of one of the larger Hepaticæ. Marchantia, asterella, or conocephalus will answer. The lively way in which the spiral elaters toss the spores about is sure to "bring down the house."

Diatoms you will find in abundance in the stomach of the oyster; but a more convenient source is common polishing powder, which consists largely of their remains.

Raw silk, cotton and wool, hair and feathers, are rich spoil for the amateur exhibitor of the microscope. Common drugs, like morphine, quinine, and strychnine—you need not go far for ready-made objects.

CONSUMPTION GERMS.

A well-known American doctor, speaking recently on the subject of consumption, accepted the germ as the chief source of the disease, and referred to experiments in which the germs had been found on the walls of rooms where consumptives had been. They are derived from the dried sputa of the patients. Animals, according to Dr. Cagny, feeding on the sputa die of consumption, and the disease has been produced by inoculating with the sputa, by swallowing it, and by breathing it. When we think of the ten thousand consumptives who every hour in the day are expectorating along our streets, and even on the floors of public buildings, post offices, churches, hotels, railroad cars, and street vehicles, when we think how these germs are being dried and carried into the air by every passing breeze, by every sweeping, and how they are capable of producing the disease six months after drying, when we think of the miscellaneous crowd sleeping in hotel bedrooms, when we think of the close, unventilated sleeping car with hangings and curtains so well calculated to catch the germs, and where, as some one has said, the air is as dangerous as in those boxes filled with pulverised sputa where dogs are placed for experiment, then when we remember that man's lungs are a regular hot house for the multiplication and growth of these seeds of consumption is it any wonder that about one citizen in every seven dies of this disease? As the lesson from these facts, our authority advises that no consumptive should be allowed to expectorate on the floor or street, and all sputa (from consumptives) should be disinfected and burned.

SUGGESTIONS FOR DYSPEPTICS.

A writer, evidently of a practical turn of mind, tells us how easily the wakeful dyspeptic can be made to slip off into the land of dreams. He says:—

"The dyspeptic, of course, eats a light supper, may resort to the use of a towel, wet with tepid water, and covered with a dry cloth, the whole then applied to the pit of the stomach. Before the sufferer knows it he will float into shadow land, such is the sympathy between the organs of digestion and the brain. Owing to the position of the stomach, a light sleeper ought to sleep on the right side instead of the left, never on the back. If there is a tendency to cold feet, a thin woollen blanket may line the lower third of the bed. The limbs ought not to be greatly flexed, a position which prevents free circulation, and they should rest one upon another lightly. The night light, where used, ought to be a tiny taper, and not gas or kerosene, both of which devitalise the air. A darkened room is the best. Nature puts out her light, and draws the curtain of darkness for a purpose. With good habits, physical and mental, and a determination not to deal with anodynes, sleep may be won from its shyest lair to watch over the restless pillow."

SOCIAL SCIENCE.

Small-Talk.

The most helpless and uncomfortable of all human beings is the man who finds himself in the whirl of society without the capacity to furnish his share of small-talk. He may be as wise as Solomon, as eloquent as Cicero; but he cannot escape the necessity which gives to triviality the place of first advantage. The conversation of the drawing-room affords him no chance to display his knowledge upon subjects of sober interest and importance. His professional learning, his literary information, his familiarity with themes of real pith and moment, can profit him little or nothing in that peculiar field of endeavour. He is at the mercy of circumstances that easily make him seem a fool in spite of all his solid acquirements. Society expects him to be agreeable, not instructive or impressive. It is worth more to him to have easy command of the lexicon of flattery and courtesy than to know the whole of Plato and to have Homer at his tongue's end. By a queer inversion of logic, the superficial is invested with more force than the profound, and success is won by skill in balancing and applying intellectual frivolities. The test of merit, in short, is one of art, and the prizes are awarded in proportion to verbal dexterity with topics that forbid serious treatment.

Many men, not great, but still fairly intelligent and proficient in their respective callings, have been placed in the predicament of finding themselves tongue-tied through a complete lack of small-talk, and have felt the humiliation of it in a way never to be forgotten. Such a trial makes a Bob Acres of the bravest individual; his courage oozes out in a cold perspiration, and a feather would knock him over. He recalls, like one about to be drowned, all that he has ever heard or read about means of escape in such cases, but somehow he can think of nothing to fit his particular emergency. It is as if he were in an alien sphere, unacquainted with the language, and fated to be stared at as an object of common derision. He longs for some voice—even that of his worst enemy—to give him a cue and help him to "catch on" where he seems to be hopelessly disconnected. Of course, he smiles, broadly and indefatigably; that is his only chance to prevent suffocation. He watches others as they glide smoothly and gracefully around him with their incessant twitter of small-talk, and envies them for the time as he never envied anybody before. They are not his equals, he may feel sure, in point of general knowledge and reasoning power; but they have facility in the matter of tossing light speeches back and forth, and that is the choicest gift of the gods, the indispensable faculty of triumph, in drawing-room intercourse. Nothing else will answer the purpose. The utmost stretch of philosophy is not equal to the task of substituting for this glittering froth a substantial and truly edifying order of discourse.

The man whose mind is stored with special wisdom, who has devoted himself to some one branch of study and investigation, thereby being fitted to talk by authority, should find his best opportunity in society; but as a matter of fact it is there that he is least useful and least adaptable. For example, there was a certain scientist in this country famous the world over for his vast discoveries, who was drawn into the social vortex on a given occasion, and placed beside a handsome young woman. She felt greatly honoured, but she was awed also, and waited for him to speak first. He stood mute, absurdly twirling his fingers, and wondering why she did not say something. The silence lasted until he could stand it no longer, and then he abruptly left her with the words: "Finding that you have no facts to communicate, I will bid

you good evening, madam." He was a fish out of water, a whale thrown upon the sands, and he did the best he could, which was bad enough, as he must have keenly realised. There was no small-talk in his vocabulary. He had an abundance of wisdom, but not the knack of putting it aside and talking only of those little things to which society resolutely gives preference.

This "tenuous reciprocity," to dignify it with a Miltonic phrase, is founded upon the theory that opinions are apt to disturb the placidity of conversation, and therefore no subject should be introduced which has two sides. The art of being agreeable, that is to say, is the art of not having any views to express that can possibly be contradicted. Your individuality must be carefully masked. You dare not assert your earnest convictions in any respect, for earnest convictions are social stumbling-blocks. "The drawing-room is, indeed, an artificial place," says a recent observer; "it is so by our choice and for our sins." We go there with the understanding that we are not to be ourselves, but shadows and make-believes. The obligation of sincerity, elsewhere so important, is there dispensed with by common consent. You are expected to wear a radiant countenance and to scatter cordial and complimentary remarks in an indiscriminate way at whatever sacrifice of personal honesty or consistency. It is not necessary that your speeches shall be true, but only that they shall be well imagined, as the Italian precept says. The great point is to tell people not what you actually think of them, but what they would like to have you think of them.

The fact is to be granted that this system of conversation meets the end for which it is designed. It compels people to restrain and conceal their dislikes, and it makes impossible all controversy that tends to excite passion and provoke harsh and cruel epithets. The peace thus secured is only an armistice, to be sure, and does not count for a moment after the guests thank their hostess for "a very delightful evening" and bow themselves back into the everyday world, where life is a battle instead of a comedy. But so long as it endures it affords a certain measure of security against malice and of immunity from detraction, and that is a relief not to be lightly regarded, however short and formal it may be. One has the satisfaction of knowing that for a few hours, at least, the dogs of war are chained, and the weapons of rivalry and enmity stacked in amicable desuetude. The man who hates you on the ordinary highway is bound in this gracious retreat to pretend that he likes you and is glad to see you; the woman who has a fixed contempt for you because you have refused to fall in love with her, or caused her husband's note to be protested, must here salute you with a simulation of perfect kindness and high esteem. You are not deceived at all; you are well aware that it is nothing but a pre-arranged sham, and yet you derive a sort of pleasure from it. The play amuses you, the actors are entertaining, partly because you are a spectator and partly because you are a participant. It is better, you tell yourself, to exchange these artificial civilities, knowing that they are nothing if not artificial, than to insist upon having the naked and disagreeable truth fully exhibited.

That was a bright woman—a French woman, it need hardly be added—who compared small-talk to the straw used in packing china. "It is nothing" she said: "Yet without it everything would be broken." There could be no society, in other words, if it were not for this quantity which conduces to the preservation of amity—which makes amity a foregone conclusion, in fact—and thus prevents the different pieces of porcelain, so to speak, from coming in hurtful contact. Experience has proved that men and women are capable of maintaining this artificial form of intercourse, when if they should undertake to be strictly frank and sincere they could not hope to have any social relations outside of their respective families. It is the small-talk that puts them on their good behaviour and inspires them with a desire not to be outdone in courtesy even though it is known to be a studied imposture. There is an implied contract that each shall be taken at his word so far as appearances are concerned; and what one thinks is for the time being an element in suspension. The straw is so disposed that jarring and collision cannot happen. Thus a basis of agreement is established which gives to fiction the practical meaning and service of truth; and society survives where it would otherwise collapse and disappear.

The great trouble, as already indicated, is that in this process of utilising intellectual littlenesses the most capable people, according to the best standards, are often of least social benefit. They have not time, were they so disposed, to cultivate the habit of dealing wholly in trifles on any occasion. Perhaps if they were permitted to air their superior wisdom at their own discretion it would not always be an improvement upon their embarrassed silence. We cannot be sure that their monologues, however instructive and popular, would suit the atmosphere of the drawing-room, or tend to insure that condition of mutual forbearance and calculated cheerfulness which small-talk now conserves and promotes. They would teach valuable lessons, no doubt, and stimulate beneficent sentiments; but would they not become tiresome, too, and put many to sleep who are now airily wakeful to the latest hour? "I commune in sentiment very much," said Ellesmere, "with Clarkson, Wilberforce and Co. about slavery and the slave-trade. I should not, however, have wished to live much with them. They would have bored me to extinction." It might be the same, we may readily imagine, with other and later men noted for their exceeding talents and virtues if they should be taken into society with the privilege of occupying as much time as they pleased in their own way. Society might be exalted for a season, but the gain would probably turn out after awhile to be a misfortune and a mockery.

Nevertheless, it is to be regretted that there are so many great and good men to whom small talk is an unattainable advantage, while there are so many persons of mediocre intellect and doubtful morality who enjoy that blessing. The patience of the social philosopher is sadly tried when he sees the kind of man that Ruskin describes as "a little floppy, soppy tadpole, with a stomach and a tail," making his way successfully in the drawing-room, when men of recognised general ability and worth are standing around as condemned and ridiculous wall flowers. Manifestly, this should not be the case. The contrast casts suspicion upon the value of first-class mental equipment in a relation of decided and constant importance. It is difficult to resist the inference that there is something fundamentally wrong in a system which thus operates to the discredit of those who are most entitled to confidence and respect, and confers the right of praise and success upon those who in other fields are never able to reach the front. That is what it comes to in all artificial contrivances. The men who are quick to learn the trick of seeming to be what they are not—the charlatans and hypocrites—are the ones who snatch the prizes and thrust better men into the background. That is the penalty that civilisation pays for the violation, necessary or unnecessary, of the principles of logic and justice.

Sale & Exchange Column—Page 352.

ARTIFICIAL LANGUAGES.

The enthusiasm for the creation of new international languages was at its height a few years ago, but is by no means over. The too well-known *Volapük* is probably the best of them, and has set the stone rolling; it tries to combine the peculiar, especially phonetic, features of most European languages. It is doing good work as a medium of commercial correspondence, but probably will never be adopted as a medium for conversation, and through the agency of time is subjected, like other languages, to phonetic and many other changes. Some attempts dating from 1891 have adopted the principle of uniting the elements of the Romance languages only into a new form of speech. "Un lingua internazional" was composed by Julius Lott in Vienna (Springergasse 32); "Un lingue commun pro le cultivat naziones" by Dr. Alberto Liptay and "fixed up" for Spanish, French, and German speaking people; another, perhaps the most consistent in its principal is "Nov Latin," by Dr Rosa of Turin. A passage taken from Lott's "Suplent folie" reads as follows: "Le doktes inter si pote usare le historïk ortografie ma le homo de komereie ese saep in dubie en use de dublkonsonantes. Sin perdite pro le klarité noi pote tolerare le skripzion; gramatika pro grammalika, etc. In il question le majorité averé le decision." In reading this sort of jargon we cannot help asking ourselves, would it not be greatly preferable to use plain French or Italian to make oneself understood?

Another more elaborate "Attempt towards an International Language" was written by Dr. Esperanto, of Warsaw, Russia, and translated into English by Henry Phillips, Jun., of New York. It combines radical elements of the Germanic and the Romance languages, and tends to put into reality the principle, that "a language of this kind must be extremely easy, so that it can be learned without difficulty." Indeed, Esperanto's grammatic rules are few in number, for they are all gathered upon four pages only. A part of the Lord's Prayer sounds as follows: "Panon nian chioutagan donu al nihodiau; kaj pardonu al nishuldantoj; ne konduku nin en tenton, sed liberigu nin de la malvera char." An International-English and an English-International vocabulary stands at the close of the small volume. The real name of the author, who has hidden himself and his ingenious system under the pseudonym of "The Hopeful," is Dr. Samenhof.

HELPFUL HINTS:

Being Answers to Correspondents.

Questions to which answers are desired in this column must NOT *be marked "Science Queries and Answers."*

IGNORANCE.—The matter is simple enough. With a convergent lens the transmitted rays of light in photographic or magic lantern projections always cut the axis of the lens at some point between the focus and the surface of the glass. Hence the inversion of the image. We would recommend you to procure one of the many elementary books in which the course of the rays is shown graphically.

G. BULBECK.—The C.G.S., or centimetre-gramme-second, unit of electric current is that which in a circuit of one centimetre length bent into an arc of one centimetre radius exerts a force of one dyne upon a unit magnetic pole, situated at the centre. The practical unit is equal to 1-10th of this. The "volt" refers to electromotive force. It is equivalent to 10^8 unit on the absolute or C.G.S. system. Each of these absolute units of electromotive force corresponds to the exertion of one erg of work upon one unit of positive electricity. The practical unit of current can be derived from the practical units of electromotive force and resistance. Thus it results from an electromotive force of one volt in a circuit of one ohm resistance. It is contained 746 times in one horse-power. We have already promised some popular articles on electricity, but have no space to deal further with the subject of your query just at present. We may inform you that the volt cannot be regarded as any "portion of a horse power" whatever.

H. BRAY.—What is called temporary hardness in water is due to carbonate of lime or magnesia held in solution by carbonic acid. By boiling the water to evaporate the carbonic acid, or by adding milk of lime to precipitate it, this hardness can be removed; for the alkaline carbonates are, themselves, insoluble in pure water. On the other hand, permanent hardness, due to the presence of soluble and stable salts (such as sulphates) cannot be removed in this way. Permanently hard water can be softened by electrolyses, but, of course, electricity is not an agent that can be applied in this way with economy on a small scale. When it is only for the purpose of washing one's hands that it is desired to soften the water, a little pipeclay may be added to it with good effect. This seems to improve the cleansing properties of very hard water, although it certainly does not "soften" it in the scientific acceptation of the term.

W. W.—The reason why your "oil of lavender" will not mix with the tincture of myrrh is probably that you are dealing with a fictitious oil of lavender, consisting principally of olive oil. Such oil is not, however, very frequently sold without an explanation to the purchaser of its fictitious character, for the unctious nature of the fatty oil is a patent evidence of the fraud. We recommend you to expose a drop of the oil to heat upon a piece of white paper. It should evaporate completely, but if adulterated in the way we have suggested, a transparent mark will be left.

C. F. PENDLEBURY.—The figures you mention are those of Professor J. Croll. Glacial epochs are believed to result from periods of high eccentricity of the earth's orbit. The variations of this eccentricity can be computed within moderate limits of time by the method of M. Leverrier, published in 1843. Thus, Professor Croll deduced the approximate estimate you mention—that the last glacial epoch extended from about 240,000 to about 80,000 years ago.

R. HALL.—Thanks for the correction. The volume of the moon is somewhat over five thousand cubic miles.

W. J. HASSALL AND COURTNEY F. DUNN, B.A.—Thanks for your letter. We have already such a mass of MS. in hand that we cannot ask you to contribute just at present.

J. J. PRINCE.—Thanks for your favourable comments. We will arrange to give some information on the subject you mention.

W. F. BROOKE.—The idea appears ingenious, but would be of no service to us at present. The "Improver" column is out of the question at present.

ST. JOHN J. C.—Thanks for your interesting communications. We regret that we cannot find room for them.

PROGRESS.—Messrs. W. & F. Hamley, 231, High Holborn, W.C.

S. L. H.—You can test it as follows:—Mix ½ oz. bichromate of potash, 1 oz. water, and 3 oz. nitric acid; after solution has taken place apply one drop of the liquid upon the surface, and wipe it off immediately with a damp sponge. If silver, it will be stained with a blood-red mark due to the union of the chromic acid with the silver. On platinum no effect is produced; on german silver a brown mark; on Brittania metal a brownish black mark, etc.; but with no other metal is the same colouration produced as on pure silver.

N. ROBINSON.—The tensile strength of cast aluminium is about 17,000 lbs. to the square inch. You can also obtain sheets and bars of still greater tenacity. Aluminium would be very suitable for your purpose on account of its resistance to oxidation. On the other hand, you must remember that, nothwithstanding its brightness, aluminium is not, bulk for bulk, any stronger than steel.

F. H. ARTS.—Thanks for your interesting letter. (1) We should be glad to hear of the authority on natural history who bears out the position you take. At present we do not know of any such. (2) We think the distance is not essential to the purpose of our paragraph, *i.e.*, to show the terrible power of the modern gun. (3) It would be not less important from your point of view that the chemical analysis of the bricks should have been detailed, and the method of manufacture exactly specified. "A brick wall" is certainly a loose term as expressing resistance to penetration. There are, however, cases in which great precision can, with advantage, be sacrificed for the sake of brevity. We have no doubt that this is one of them.

J. ANDERSON.—To clean and brighten the brass work it should be dipped in a boiling solution of carbonate of soda, to which a little lime has been added. It can then be dipped in a mixture of equal parts of nitric and sulphuric acid, rinsed in water, and dried.

BAROMETER.—Yes; the luminous paint can be prepared in the way you describe from powdered oyster shells and sulphur. You will find it much better and cheaper, however, to buy it ready made.

J. M.—Yes. You may use either bichloride of platinum, sulphide of ammonium, or nitrate of copper. Either will suit your purpose; the platinum will, however, give the purest black.

J. S.—The information is to be found in our own advertising columns.

For "SALE AND EXCHANGE" Column see Page 352.

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LONDON: SATURDAY, MARCH 26, 1892.

SCIENCE NEWS AND NOTES.

"It is impossible to overvalue the power which the soul has of loving truth and doing all things for the sake of truth."—PLATO.

Poisoning by Arsenical Wall Papers

is a serious question that has been exercising both medical and lay minds for the last five years. The possibility of the thing has been frequently affirmed and just as frequently contradicted. The last scientific contradiction took the form of an atmospheric analysis of a room papered with a notoriously arsenical material, and we were told that the amount of arsenic found in the air of the room was insufficient to even affect health, leave alone to jeopardise life, in the slightest degree. This satisfied everybody until the next opinion came along, which is to be found in a published letter of Dr. W. Harding, of the County Asylum, Berry Wood.

An Example of Arsenical Poisoning—

a good example, Dr. Harding terms it—has just occurred at the Berry Wood Asylum. He says:—"In the endeavour to make the wards of an asylum bright and cheerful, and to do this at as little expense as possible, it is not improbable that the nature of the colouring materials used may be overlooked, and that some of the gastric and intestinal disorders which disturb the peace of mind of medical superintendents may be cases of arsenical poisoning." For a long period the nurses at Berry Wood were in poor health. First one and then another was laid down until, within a few months, nearly every nurse on the staff had been, or was, under medical treatment. Headache, neuralgia, gastric derangement, loss of appetite, constipation or diarrhœa, irritation of eyelids, anæmia—these were the chief symptoms complained of. Drugs did not appear of much avail, but a holiday had a marked effect for good. At last one nurse had the eye symptoms in a more pronounced form, and suspicion was aroused. In each nurse's room was a green baize curtain, used as a covering for dresses, etc. A portion was taken and examined. It was found to be impregnated with arsenic to an astonishing extent. These curtains were removed; the rooms freely ventilated; medical treatment was stopped; the symptoms disappeared and, though some months have elapsed, have not returned. The baize was similar to that used for covering doors, etc., and was obtained from two manufacturers. Here is a proof positive of the evil of green dyes, better than all the theoretical tests based on analyses of atmosphere. We do not say that all green materials are bad, but we do advise our readers to err on the safe side and shun them whenever possible.

Insanitary Dwellings

is the subject of a letter by Dr. H. Mallins, addressed to the *Lancet*. He writes it for the purpose of placing on record an unequivocal case of the origin of diphtheria from faulty drainage, which came under his observation. The case was that of a boy ten years of age, who was attacked with membranous sore throat, followed in a few weeks by almost universal paralysis, a circumstance that proved its true diphtheritic nature. On endeavouring to trace the source of infection Dr. Mallins found that the bed in which the boy slept was in a small room directly over the scullery, and that a most unpleasant smell had been noticed to pervade this room for weeks past. On examining the scullery sink it was found to communicate by an untrapped—in places broken—pipe with a cesspit situated about twenty-five yards from the house. There was, therefore, every opportunity for the foul air from the cesspit to be syphoned into the house. The patient was carefully isolated, and though one of a very large family of children no one else caught the infection. As there was not a single case of the disease in the neighbourhood, as the boy did not mix with any children except his own brothers and sisters, and, lastly, as he was the only one in the family sleeping in the line of escape of foul air, the conclusion seems irresistible that in this case, at all events, the diphtheritic poison was conveyed in the emanation from a foul drain, such emanations polluting the air that was nightly breathed. How the specific bacillus got into the cesspit is, of course, a very difficult matter to explain. Here is a case in which prevention might have saved much unnecessary suffering. If the house and precincts had been efficiently inspected by a competent engineer, the imperfect drainage could never have existed, and the consequent evils would have been averted, The warm air of the house will attract sewer gas from outside, therefore inspection should not be confined to the "four walls." Our own sanitary inspectors have been very busy since we started "The Science Sanitary Association," and we have already unearthed some very bad cases. Those of our readers who have not already subscribed to the association should do so at an early date, as we shall be compelled to put up the price of the subscriptions in order to cope with the increased organisation necessitated by the growth of the business.

Broken Hearts

are more plentiful in fiction and metaphor than in reality. We have, however, already reported a few well-authenticated cases in our columns, and we now hear of another. A carman, aged thirty-one, was found a few days ago lying on his face at his horse's feet quite unconscious, and was taken to the Seamen's Hospital at the Albert Docks. He remained insensible for nearly an hour, and then, after partially regaining consciousness, expired. The *post-mortem* examination revealed a laceration, about a quarter of an inch in length and an inch in breadth, at the top of the heart. There was nothing to prove that it resulted from anything save a fall and a natural weakness of the organ.

Gold From the Heavens

sounds almost like the financial man's paradise which was paved with the precious metal. It appears, however, to be a fact, that either the celestial atmosphere or some of the bodies therein may prove a big source of wealth to the earth. The discovery is due to an American geologist, Mr. H. W. Turner, of Washington, D.C. This gentleman has just been exploring the gold regions of the Sierras, and has obtained from a gulch at Cave City, Calaveras County, a meteoric stone, about as large as one's fist, around a good portion of which is a solid film of gold. This is, we believe, the first meteoric iron found in connection with gold, although other precious things have been found in stones of meteoric origin. One meteor, about one by two feet in size, containing a number of red diamonds, was discovered near the Colorado River, in Arizona, by Prof. William D. Johnson. This last discovery is a most important revelation to science, since it has never been previously determined that there was either gold or silver in meteoric iron. It demonstrates that there is gold in the worlds of space from which the meteor has fallen, although the hypothesis may hold good, as it has not yet been split, that it is only thickly plated with gold through contact with some earthly source. The find is intended for the Smithsonian Institution. Since the above was written, we learn that a small piece, after great trouble has been cut from the meteor. It is clean and white looking, resembling nickel, and showing "a very tough grain." The gold, which is plentiful, flecks the iron in many places.

Long-Distance Telephoning

is making very rapid strides towards perfection. Some experiments, just carried out in Philadelphia, resulted in conversation being distinctly heard after a round circuit of 1,200 miles. In operating over great distances the same difficulty is met with as in the use of telegraphic wires. The current loses its power by the earth's induction. It is stated by one of the experimentalists that the disturbing influences which affect the transmission of sound by the telephone may make it eventually necessary in Philadelphia to introduce metallic circuits on all the wires connecting telephone subscribers with the main office. This authority says: "You may have noticed how still and smoothly the sounds come over the wires of the long-distance telephone. As distinguished from this, you frequently hear a buzzing noise and other strange sounds coming over the wires where the ground circuit is used. You can talk distinctly over wires connected by metallic circuits for almost any distance. The sounds are always smooth and distinct."

The "Ginger Beer" Plant

sounds rather a trivial subject to engage the attention of scientists. It possesses, however, much interest, although the plant is only used to make an effervescing drink in a few country districts. Dr. Andrew Wilson tells us it partakes of the nature of yeast, and that its action is analogous to fermentation. But he was not prepared to find on looking into the question of data, that so little was known regarding the ginger beer plant by botanists. Professor Bayley Balfour, then of Oxford and now of Edinburgh, informed him that the exact nature of the "ginger beer plant" required working out. This task has now been accomplished. Professor Marshall Ward has analysed out the "plant" into a very curious case of association between two groups of fungi related to the yeast tribe. The "plant" thus represents a case of what biologists call "symbiosis"—that is, the association or kinship exhibited between two (or more) different organisms for purposes of the common life. One species finds it to its advantage to be associated with another species, and so a kind of biological friendship (not of a quite disinterested kind) is struck between the two organisms, and the kinship is perpetuated accordingly. Of late years we have had numerous examples brought to light of this "symbiosis"; but it is curious, to say the least, to discover that the familiar "ginger beer plant" represents in itself an example of this communal life hitherto unsuspected by the scientific mind, possibly on account of its ultra-commonplace nature. After all, a good many of the real wonders of life environ and encompass our daily footsteps, and, for the most of us, remain neglected and unknown because we have not been trained at school to read the language in which Nature speaks to "the heart that loves her."

A Natural Sulphide of Gold

is said by Mr. T. W. T. Atherton to exist in the ore of the Deep Creek mines, New South Wales. The lode is a large irregular one of pure arsenical pyrites, existing in a felsite dyke near the sea coast. Surrounding it on all sides are micaceous schists, and in the neighbourhood is a large hill of granite about 800 feet high. In the lode and the rock immediately adjoining it are large quantities of pyrophillite, and in some parts of the mine are deposits of this pure white translucent mineral, but in the ore itself it is a yellow and pale olive green colour, and is never absent from the pyrites.

The Extremely Fine State of Division

in which the gold existed in the ore first caught Mr. Atherton's attention. After roasting and very carefully grinding down in an agate mortar, Mr. Atherton was never able to get any pieces of gold exceeding one-thousandth of an inch in diameter, and the greater quantity is very much finer than this. Careful dissolving of the pyrites and gangue so as to leave the gold intact failed to show particles of any larger diameter. This, as mining experts are aware, is a very unusual experience, and naturally led to further tests. Ultimately, after a number of experiments, there was nothing left but to test for gold as a sulphide.

Taking 200 Grains of Pyrites

from a sample assaying 17 ounces fine gold per ton, grinding it finely and heating for some hours with a solution of sodium sulphide (Na_2S_2), on decomposing the filtrate and treating it for gold, a result at the rate of 12 ounces gold per ton was obtained. This was repeated several times with the same result. The sample came from the lode at the 140-foot level, while samples from the higher levels, where the ore is more oxidised, although carrying the gold in the same degree of fineness, did not give as high a percentage of auric sulphide.

All the Gold

in the pyrites, it would appear, has originally taken its place there as a sulphide. The following is an analysis of a general sample of the ore: Silica, 13·940 per cent.; alumina, 6·592 per cent.; lime, 0·9025 per cent.; sulphur, 16·584 per cent.; arsenic, 33·267 per cent.; iron, 27·720 per cent.; cobalt, 0·964 per cent.; nickel, traces; gold, 5 ozs. 3 dwts. 8 grs. per ton; silver, 16 dwts. per ton; total 99·969 per cent.

"Science Siftings" in the Sky!

Our advertisement upon the clouds! Is it possible that we should put it there? We will not answer that the thing is possible, but we believe it may very easily be so. In this matter we speak with the authority of a well known optician who has been consulted as to a novel and very striking method of advertisement. The invention embodies the optical projection of letters or other advertising devices, as luminous characters or pictures of large dimensions, upon the clouds at night. It embraces also a special system of lenses with which the optical lantern, for the projection of images upon so great a scale as will be necessary, is to be provided. A patent specification (No. 3775) has been lodged, and will shortly be completed. We shall have more to say upon the subject by-and-bye.

The Most Economical Light in the World

is the brilliant point on the tiny glow-worm. How does the glow-worm manage it? Dr. Andrew Wilson considers the solution of great importance as far as the future of electric lighting is concerned. The glow-worm does not spend its energy uselessly, and what we have to aim at is the discovery of some illuminant which shall also be a source of light, and of nothing but light. It seems that we are still unable to manage our light-manufacturing business as well as the glow-worm. We are still shooting flies with cannon. In a candle, for instance, the combustion produces, in addition to the light which we do want, a quantity of heat which we do not want, and the worst of it is that by far the greater part of the energy contained in the candle has to be devoted to making much of what is no use to us for the sake of obtaining a little of that which we really require. The glow-worm could never afford to produce his beautiful little illuminant in the same wasteful fashion that we follow in our lamps and gas burners. What we want is some contrivance by which the fuel which we intend for illumination shall be chiefly, if not solely, devoted to this purpose. That it is possible to obtain an immense saving in the cost of the production of light will be evident from the following fact.

A Gallon of Petroleum

burned in our best lamps will give out a certain amount of light; the same amount of petroleum consumed in a properly constructed engine can be devoted to the production of power, this can be made to turn a dynamo which can produce an electric light. If we take the light given out by a standard candle while burning for an hour as a unit, we can express the units produced by the petroleum in the two cases, and we find that we get ten times the quantity of light out of it by transforming it into electricity than would be obtained by burning it directly. This is a great advance, but there is still some heat produced by the electric light, and we must get rid of this waste as far as possible before we can attain the perfection of the glow-worm as a light generator. It is from this point of view that the extraordinary experiments with which M. Tesla has so recently delighted London become of much interest. In many of his striking demonstrations electric light was produced of a character which leads Dr. Wilson to hope that we may yet be able to rival the glow-worm as a light yielder before we have been able to rival the birds in their power of flight.

A Lake of Molten Lava,

known as Halemaumen, which formed in the crater of the volcano of Kileaua, on the Island of Hawaii, last April, has been steadily increasing in depth and size till it is at least 1,200 feet in length and 300 feet in depth. It is of irregular, oval form, and surrounded by almost perpendicular walls. "What a sight it presents!" writes a correspondent of SCIENCE SIFTINGS. "Golden red lava spouting, seething, hissing in every part of this large caldron; never still, but ever moving, rising or falling, and flowing steadily toward the centre, where it seems to pour back into, and descend through, the same vortex from which it is continually ejected as from a fountain, 30 to 50 feet high, near the centre of the lake. Besides these large fountains, which seem to feed the lake and keep it supplied with fresh lava for the grand display, there are innumerable smaller ones playing in every part of the lake, reminding one of the splash when a cannon ball falls into the water. The number of these is very large, and quite impossible to count when the lava is very active, as they are constantly in motion, some disappearing and new ones being formed. At this time they probably number 1,000, the smaller ones resembling torches, the larger ones miniature fountain jets, varying from two feet to ten feet high, but all surpassingly brilliant.

How They are Formed

has not been accounted for, but, like meteors, they come unheralded and then disappear. The shores, like the illuminations of this grand lake, differ from any previously seen by the writer. Former lakes in Kileaua have been surrounded by caverns into which the lava was driven, thrown up and out with a splashing noise. This one is different in this respect, in being surrounded on every side with a shore like that of a fresh-water lake, on which the molten lava flows up like water on the shore. The resemblance is perfect, wave following wave, the white foam of the water being changed to a brilliant red in all its various hues, but otherwise a perfect sea beach surrounds the whole lake. Now, picture such a scene of molten sea, with its red waves, breaking gently along the shore and receding, followed by successive waves painted in most brilliant red, and always in motion. The interior of the lake is marked with innumerable red ripples, and scattered among the whole are a thousand lighted torches, all in motion, forming a changing panorama, and you have a picture of the lava lake as it is now seen, one of the rarest and most beautiful sights ever exhibited in the volcanic history of this or any other country. It is a picture which no artist can paint, no pen fully describe, and no person fully comprehend without seeing it.

A Startling Phenomenon

occurred lately in the department of Cuzco in Central America. About midday an ærolite came almost in contact with the earth. It crossed in a southerly direction all along the eastern region of the Cuzco, with as beautiful and luminous a tail as that of any comet ever seen. Before disappearing, the meteor changed its course and rose about 30° higher than when it was first seen, when a terrible explosion was heard, and immediately afterwards a light shower of pebbles fell throughout that neighbourhood.

GLEANINGS OF THE GLOBE.

THE French Government is about to erect an observatory at Tunis in North Africa.

IT is stated that since last October, in addition to the ordinary cremation in France, more than 4,614 bodies have been sent from the hospitals to be cremated.

A PARISIAN electrician, it is reported, has succeeded in forcing violets by the aid of his battery, and recently sent a bunch of these fledglings, only four hours old, to the ex-Empress Eugenie.

MESSRS. AUGUSTUS AND LOUIS LUMIERE, whose scientific and experimental entertainments are well known, have just successfully repeated Mons. Lippmann's experiments of the reproduction of the colours of the spectrum.

AN automatic mark-buoy for wrecks comes from America. The buoy is fixed to the deck of the vessel by a joint of soluble glue, which on dissolving in the sea water allows it to rise to the surface. The soluble joint is made to give way after stated periods of, say 24 or 48 hours.

EVERY hall or church has its keynote, and the audience will hear better if the speaker's voice is pitched and held to the keynote of the room. To find the keynote sing the natural scale slowly, evenly and smoothly, or play this scale on piano or organ. The note which is most prominent is the keynote.

AN infant loses from 3 to 6 ounces in weight during the first four to six days; by the seventh day it should have gained its birth-weight; from that time to the fifth month it ought to gain about 5 ounces per week, or about 6 drachms a day; at the fifth month it ought to have doubled its birth-weight, and in sixteen months quadrupled it.

PHYSICIANS headed the list of suicides in America last year, and they have headed it every year in the last ten. This promises to be still more conspicuous this year, as in the first twelve days of the present month no less than seven physicians have committed suicides in the United States. There seems to exist no satisfactory solution for this state of affairs.

ROCKS are disintegrated by vegetable organisms as well as by atmospheric agencies. It is well known and distinctly observable that plants of various kinds fasten themselves and grow from the surface and fissures of rocks. In their growth, they gradually assimilate such substances in the composition of the rocks as are needful for plant growth, and thus the hardest rocks may be gradually disintegrated.

THE steaming of a kettle and the contractions of a frog's leg have in a short century allowed the development of navigation, land travel, and factory work, of electricity, electric light, and gases, of the telephone and telegraph, in a most wonderful degree. Who could have thought of this? and who knows what may be in store for the future, among the known, or yet unknown and future, discoveries of science?

HABITUAL drunkards are cared for in a singular and withal effective manner in Norway and Sweden. The penalty is imprisonment, and during incarceration they are fed on bread and wine, no water being allowed them. The bread is steeped in wine for an hour before it is brought to the cell night and morning. It tastes good at first, but after eight or ten days the prisoner is so nauseated by it that he refuses it. The cure is considered quite as effective as any treatment can be.

A PHYSICIAN has observed near-sight is hereditary, but a larger percentage prevails among blondes than brunettes. His experience has taught him that the period of youth, when the eyes are used for study, is the age when most defective vision becomes apparent. This would bear out our contention that it is the extreme haste—for we all know the youthful habit of "skimming" books, more than the lack of exercise, to which we owe the deterioration of our vision.

MEDICAL men are agreed as to the poison inseparable from the finger nails, whether used only in everyday avocations, or in handling special merchandise, papers, and such like. Mrs. Howard Paul, of 11, Museum-mansions, Great Russell-street, who is well known for her skill as a manicurist, tells us, however, that if the nails are kept well trimmed and polished there is not the same likelihood of poisonous matter adhering to them, therefore many medical men advise periodical visits to the "manicurist."

SOME interesting and rather surprising statistics on the use of the telephone in European countries have been collected. In London, the greatest commercial city of the world, only 1·5 persons in 1,000 use the telephone. The telephone is used most in countries where the service is owned or controlled by the State. In Germany Switzerland, Norway, and Sweden, from 100 to 400 persons in every 100,000 of the population are subscribers. In Great Britain, only 58 persons in 100,000 use the telephone. In Berlin 11, and in Paris 4·2 out of every 1,000 inhabitants use the telephone.

AT Tring Park, the residence of the late Baron de Rothschild, a number of kangaroos were brought from Australia and turned loose into the park and woods in hopes of breeding them. Unfortunately, a male and young one were poisoned from eating the pernicious Portugal laurel. Fresh ones were imported, and the greatest success has crowned the efforts to breed and acclimatise in England. They have done so well that there are now in Tring Park twenty-eight or thirty native kangaroos, including the black and red species, Bennett's wallaby, the black wallaby, and the large *Macropius* or giant kangaroo.

FEW people understand the difference between a heliostat and a heliotrope. The former is a mirror moved by clockwork in the path of the sun so as to throw reflections in a desired direction. The latter is a field mirror. The most remarkable thing about both is the distance to which the flashes may be thrown. A mirror of 1 inch in diameter is distinctly visible without the use of a glass at the distance of eight miles, while two miles away it looks like a very bright star. With either the heliostat or the heliotrope it is possible to signal from one mountain top to another eighty or 100 miles distant, and, in fact, experiments have shown that signals may be transmitted from one mountain top to another in the Rocky Mountains, without the least difficulty, a distance of ninety miles.

TO INVENTORS.—Anyone having a good Invention can, on applying to the Editor, "Science Siftings," obtain the advice and assistance of a well-known Patent Expert, free of charge.

SCIENCE QUERIES AND ANSWERS.

A prize of two shillings and sixpence will be awarded for every interesting question asked by our readers and published in this column, and five shillings will be given for every answer published. In all cases when a similar question or reply is sent in by two or more correspondents, the award will be given to the one whose letter is first opened, provided the subject is properly treated. Questions asked by correspondents and not replied to by our readers, may, if of sufficient interest, be dealt with Editorially.

Rules for Competitors.—(1) Only one question may be sent each week, but any number may be answered. (2) Write on one side of the paper only. (3) Envelopes must be marked "Science Queries and Answers," and must arrive not later than the Monday following date of publication.

The following are Answers to Queries published in No. 21.

49.—What is the minimum food consumption on which human beings can subsist?

Food is fuel, or "latent" chemical force, which, by the processes of the body, is transformed into mechanical and thermal energy. Supposing loss of heat to be prevented, the expenditure of energy that is necessary to existence will be almost wholly limited to that of the involuntary functions of the heart and lungs. According to Dr. McKendrick, the daily work of circulation and respiration is equivalent to nearly 62,000 kilogrammetres. Supposing, then, that the food materials are wholly digested and completely oxidised, it is only necessary to calculate the heat due to this combustion, as it takes place in the body, and the equivalent in mechanical energy of this heat, in order to determine an absolute minimum of necessary food. The mechanical value of different articles of food has been estimated to be as follows:—Beef fat, 3,841; butter, 3,077; flour, 1,627; hard boiled eggs, 966; lean beef, 604; potatoes, 422; milk, 266; cabbage, 178 kilogrammetres per gramme. A healthy diet consists of proteid in the proportion of 12 grammes; fat, 9 grammes; and carbohydrate, 33 grammes. The mechanical equivalents of these three forms of food may be taken at 1,812, 3,841, and 1,657, respectively, in kilogrammetres per gramme, whence it follows that the average value for healthy food is about 2,055, and that the answer to the question is—at least 62,000 ÷ 2,055, *i.e.*, 30 grammes, or a little over one ounce, per day.

50.—What are the effects of alcohol upon the human frame?

Alcohol is a mild anæsthetic and sedative. It is a source of heat energy, but, owing to the paralysing action which it exerts on the vasomotor system, a dilatation of the cutaneous vessels occurs, resulting in additional blood supply to the surface, increased loss of heat, and eventually a diminution of the temperature of the body. The increased frequency of pulse that is usually observed is not directly due to the alcohol, but is the result of a condition of excitement. If the body remains quiet it will scarcely be noticeable. Alcohol blunts the sensibility of many organs; for instance, of those which are concerned in the sensation of cold. It excites hunger, but to some extent retards digestion. It also interferes with the physiological functions; and the powers of clear judgment and reason are paralysed. Emotional life being brought into free play, unhampered by the guiding strings of reason, dangers and difficulties are no longer foreseen, and not only physical, but also mental suffering is allayed. The sense of fatigue is deadened; but the sensation of tedium (one of the greatest incentives to exertion) is at the same time diminished.

51.—In what position would a terrestrial body be most powerfully acted on by gravitational force?

If the earth were a homogeneous sphere, the greatest intensity of gravitation would be, as it is commonly supposed to be, at the polar surface. Since, however, the density of concentric layers in the earth increases from the surface to the centre, it has been calculated that gravitational force is at its maximum at the bottom of an imaginary pit, sunk to a depth of three-tenths of the earth's radius.

52.—When was magnetism first used for the extraction of particles of steel and iron from the eye? And by what means is this agency now applied to that purpose?

A loadstone, *i.e.*, a permanent magnet, was first used for this purpose, by Fabricius Hildanus, about 1650. Electromagnets are now employed, which are light enough to be easily handled, but sufficiently powerful, when excited by means of a quart bichromate battery, to sustain a piece of iron weighing as much as 6oz., at the end of a needle-like pole piece. This magnetised polar needle is usually about two inches long, and may be less than 2 mm. in diameter. A very delicately mounted magnetic compass needle may be employed to *indicate* the presence of a chip of steel concealed within the eye.

53.—What natural cause regulates the very different consumption of salt in different communities?

Common salt is a necessary article of diet, but is found in different food stuffs in very different proportions. The need for salt, as an accompaniment to those articles of food in which it is absent or deficient, is interpreted by Nature by a craving, the force of which can only be appreciated by those who have undergone a total deprivation of salt, and of food impregnated therewith, during an extended period. The relative quantities of salt in different kinds of food is stated to be as follows (in parts of Na_2O per 1,000 parts); bullocks' blood, 19; beef, 3; human milk, 1·5; peas, ·17; beans, ·13; rice, ·03. It follows from these and many other determinations of the quantities of salt in animal and vegetable foods, that, in the latter class, a relative deficiency of this needful constituent exists. We find among tribes of hunters and among beasts of prey but little, if any, desire for for salt. Herbivorous animals, on the other hand, and peasants who often live almost entirely on vegetable food, experience a painful longing that will be satisfied, when possible, by salt obtained at almost any price. Thus the amount of salt demanded by nature through the appetite varies, in a clearly intelligible manner, with the constitution of the staple diet. When, however, it is not merely as an aliment but as a condiment that salt is used, the laws of demand and supply cannot be formulated by any scientific rule. It is enough to say that, in such circumstances, the consumption may easily become excessive and injurious.

54.—In what way is the density of the earth determined as against that of a mountain?

By the deviation of a plumb line, in a form of the instrument known as the zenith sector. The true zenith is determined by an astronomical observation, whence the deviation of the plumb line from its normal condition of verticality may be accurately measured. This deviation is due to the gravitative attraction of the mountain for the plummet, and it enables the relative gravitation of the earth and of the mountain to be deduced by the well-known laws of composition of forces. Since we can also determine the magnitude and the average specific gravity of the mountain without difficulty, and since we know the magnitude of the earth, it follows that the density or specific gravity of the latter can be obtained by a simple process of arithmetic.

QUERIES.

Replies to the following Queries must reach the Office by Monday at latest; and those selected will be published in the issue after next.

61.—By what means is the distance between the earth and the sun determined ?

62.—By what rule must the composition of a healthy diet be determined ?

63.—In what circumstances can a photograph be taken with the greatest rapidity by the sun's light ?

64.—How often do transits of the sun by Venus take place ?

65.—Is it a fact that some animals can see in what is to us darkness. And if so what explanation can be given for the fact ?

66.—Are there any important planets between the sun and mercury ?

SEA-SICKNESS CURED AT LAST.

In a recent issue of SCIENCE SIFTINGS we commented on a chemical remedy for sea-sickness, and we have now to herald what promises to be an absolute mechanical cure. It is the invention of no less eminent a ship-builder than Mr. Thornycroft. This gentleman has designed an apparatus which by reducing the pitching and tossing of vessels at sea to a minimum, will have not only the good effect of overcoming the terrible *mal de mer*, but should prove of signal service in steadying men of war when in action. Mr. Thornycroft intends submitting his invention to the next meeting of the Institute of Naval Architects. The inventor commenced his experiments on board his own yacht "The Cecile." During a stay that Mr. Thornycroft made at Havre last year, he made a trial with his apparatus, and had on board the directors of one of the most eminent French engineering companies, who were so delighted with the results that they immediately secured the monopoly of the rights for the whole of France.

We will give our readers a brief summary of the particulars of the invention which have been communicated to a representative of SCIENCE SIFTINGS :—At the ship's side a sensitive pendulum is suspended, of which the least inclination to one side or the other, resulting from what one might describe as incipient rolling of the ship, effects a contact with one or the other of two needles. This contact is the means of completing one or the other of two electric circuits, which control machinery for moving a heavy counterpoise to port or starboard as the case requires. If the ship tends to roll to starboard, the pendulum, upon the first indication of this motion, contacts with the pin upon its left and promptly sets the machinery in motion to shift the piece of "movable cargo" that we have already mentioned, to port. The desired steadiness of the vessel is thus attained. The apparatus may be placed in any part of the vessel, and works without any noise or inconvenience. As to its weight, it is small compared to the total tonnage of the vessel, and is regulated also by the degree of steadiness required. It is estimated that an apparatus of the total weight of 125 tons, produces a very satisfactory result on a vessel of 8,000 tons. We trust that the further application of this ingenious apparatus may bear out the results obtained in "The Cecile" experiments. Mr. Thornycroft's invention should render a real service to maritime navigators.

BACK NUMBERS.

Any difficulty in obtaining back numbers of "Science Siftings" should be immediately notified to the Manager, "Science Siftings," 78, Fleet Street, London, E.C., who will give the matter his prompt attention.

CRANIUMS AND CRIME.

The relation of the formation of the skull to crime is a study which is being pursued at the present time with the keenest interest by eminent medical scientists. French physicians have pushed their researches further, probably, than those of any other nation, and have almost conclusively demonstrated that atavism is almost certain to produce the criminal. By atavism is meant the reversion of type in the evolutionary series, or a tendency to return to the ancestral type in producing variations of structure or malformations which are normal structures in some of the lower animals. The relation of the skull to crime has not been studied from a phrenological standpoint by these physicians, for the reason that phrenology lays down certain general laws which phrenologists claim will govern in every case, and, as none of these physicians are believers in the theories of phrenologists, they have been discarded as worthless, at least in making researches in the subject under discussion. Murder is classed in law as the worst form of crime, and the study of the formation of the skulls of murderers has been diligently pursued by scientists until they are now able to make some remarkable disclosures.

It is not claimed that all murderers have peculiarly shaped skulls; on the contrary, many of them are possessed of as classical and fine-looking heads, to the casual observer, as the scientists, the divine, or the educator. The motive for the crime must be taken into consideration. The murderer who carefully plans his awful deed and then deliberately executes it; the murderer who kills for the love of the crime; the murderer who is first thief and then murderer, and the murderer who puts a fellow-being out of the way in order to cover up another and lesser crime cannot all be considered in the same light. Recent developments show that in nearly all cases of wilful and deliberate murder, the murderer is possessed of a skull in which very marked peculiarities of construction are noticed. Such a man has the mark of a murderer upon him as clearly as did Cain. The devil has marked his purchase. Is there such a being as the born murderer? Upon this point eminent medical authorities differ. Researches and investigations made in recent years go to show that such is in all probability the case. There are children born to become murderers; born so because the peculiar formation of the skull exerts certain influences upon the brain which produce the murderer despite any effort the individual may make to restrain his vicious tendencies.

These are cases of record where the murderer executed his bloody deeds purely for the love of them. One case in point is that of a degraded mortal whose face struck terror into the hearts of everyone who ever saw him; a man who could no more restrain his passion for murder than the starving savage could dispel the cravings of his empty stomach. He murdered, not for any purpose, but purely for the sake of committing his awful crime. He murdered, not for money, but for pleasure; it was a pleasant sensation to him to see his dying victim writhing in the throes of death and to give the final dagger plunge which laid the sufferer cold and still in death. The skull of this human monster is of a lower type than that of the monkey. It was elongated until the face became a fright; the eyes set deep in their sockets resembled burnt holes in a blanket; the forehead was low and receding, and the top of the cranium flat, as though depressed by exterior and unnatural pressure; the posterior of the skull was fully developed, showing that the animal nature of the monster's brain was his ruling passion. The skull we have described shows the most pronounced case of atavism of that of any murderer known. He was

certainly a born murderer. He murdered a defenceless shopkeeper in 1853, and soon after paid the penalty for his varied and horrible life of crime. He was guilty of many crimes in his youth, and became a murderer while still young. He was cunning and crafty, and easily evaded the police. A study of his skull reveals the fact that the brain was so depressed in the fore part of the head as to render the man devoid of all intellectual qualities. The brute forces only were allowed full away. The effect which this had upon the brain is plainly to be seen, and scientists declare that the formation of the skull is alone responsible for his atrocious deeds.

These same scientists declare that as the skull retrogresses towards the animal formation, so do the morals and intellectual qualities of the brain decrease. This assertion seems to be wholly borne out by facts. It will be found that almost without exception that wilful, deliberate murderers are possessed of heads of such apparently peculiar formation that they would at once be stamped as dangerous and vicious men by any one familiar with the subject of skull formations. In the cases of men who are thieves first and murderers afterwards the head is of a higher and more intellectual order. In the cases of the men who commit their crimes in the heat of passion there is almost an universally better appearance than in the case of heads of more brutal and bloodthirsty murderers.

We take the case of a murderer who was hanged a few years ago for the murder of a defenceless old man. The murder was entirely without provocation, and was so cold-blooded as to cause a perfect storm of public indignation. The murdered man was standing in front of a new building, when he was shot. There was no cause, no quarrel, and the deed seemed to have been committed without premeditation, yet there was little or no feeling of remorse apparent in the murderer, who was immediately arrested and soon brought to trial. He was convicted of murder and sentenced to be hanged. There was great diversity of opinion as to whether or not the man ought to have been hung, but the law was allowed to take its course. An autopsy was held, and the examination of the skull revealed one of the most remarkable formations on record. The murderer's cranium was a solid bone, premature ossification of the sutures, lines of union, or seams, between the bones of the skull, having taken place. The ossification of the suture between the parietal bones had produced a sort of ruffle of solid bone, extending from the suture between the frontal and parietal bones to the occipital. This ruffle is thicker than any other part of the skull, and is consequently raised about one-quarter of an inch above the general surface of the bones. At the top it is about three-quarters of an inch in width, and gradually widens until at the base it is over an inch in width.

All of the sutures were ossified, and the ossification must have taken place early in life, thus causing a stoppage in the growth of the skull, and a consequent stoppage in the growth of the brain. In the normal skull, the sutures, or seams, between the several bones of the cranium remain open, and the bones of the head are only loosely joined together. This enables the brain to grow, and as it grows the skull expands to sufficient size to comfortably contain it. In the murderer's skull, to which we refer, with the sutures ossified, the brain was compressed into a smaller space than it should have occupied. In the years it was thus confined, it continued to grow until the bones of the skull were reduced to a sixteenth of an inch in thickness in several places, and the temporal bones were unevenly forced from their normal position, thus rendering the skull lopsided, with greater curvature on one side than the other. The skull when held up before a light was so thin in some places that the light could be seen through it as plainly as through greased paper. On either side of the ruffle, that we have described, and extending parallel to it, was an elliptical indentation about a thirty-second of an inch below the surface of the bones of the skull. These indentations are about two and one-half inches in length. The confinement of the brain in this solid cavity was very like placing it in a vice. All chance for mental activity was lost, and in case of a rush of blood to his brain the man's mental balance was for the time gone, and he was irresponsible for his acts.

Generally speaking, the criminal may be said to be an incomplete being. He is tainted with a morbid inheritance, and shows signs of physical and psychical degeneration correlative to the imperfection of the development. The skulls of female thieves and lewd women are generally of a very marked character, and the former are generally of a higher order than the latter. The prime diameter of the skulls of thieves, as well as their horizontal circumference, exceeds that of women who habitually offend the moral laws. The physical degeneration due to imperfect organisation shows itself among such women principally by the frequency of deformities of the head, of anomalies of the cranium, of the latter of which there are 41·33 per cent. Their psychical abnormality is exhibited either by feebleness of intellect or by a notable absence of the moral sense. The craniums of other criminals show marked deformities in a large majority of cases. Some have heads which are noticeably flat on top, more square than normal, and with marked fulness from the temples back. Another skull with marked peculiarities has the forehead high and narrow, eyes deep set, and the outlines generally those most commonly found on the heads of thieves. The owner of this ugly skull was a thief first, and became a murderer by killing the officer who attempted to arrest his flight from prison. The skull bears the marks of the thief, and not those of wilful, deliberate murder.

The skull of the Australian aborigine, is the nearest approach to the orang type of that of any human being. It is truly an animal head. The forehead is exceedingly flat and recedent, while the prognathism of the superior maxillary almosts degenerates into a muzzle. The alveolar arch, instead of being round or oval in outline, is nearly square. The whole head is elongated and depressed in the coronal region, the basis of the cranium flat, and the mastoid processes very large and roughly formed. The immense orbits are overhung by ponderous superciliary ridges. The Australian is crafty, cunning, brutal, and blood-thirsty, placing little or no value on human life. He is at the same time cowardly and weak.

The Malay race shows another low form of skull. There is little breadth and height to the skulls of this race, and the facial angle would do no credit to the Caucasian. He has been termed the tiger and the serpent of the East. He is subtle, crafty, excitable, unprincipled, sensual, and cruel.

The Flathead Indian has been another interesting study. The question naturally arises: Does the unnatural depression or flattening of the skull of the offspring of this tribe by means of a board fastened upon the head of the infants, and the consequent and necessary rearrangement of the hemispheres of the brain contrary to all the natural laws, cause the tendency to murder so noticeable among this tribe? Indians, as a rule, are a murderous people, and the fact is indicated by the formation of their skulls, but does the further contortion or malformation of the skull out of the normal condition render the individual members of the Flathead tribe more subject to crime? The answer

of many scientists is yes, while a few contradict it. The Flathead Indians are of a lower type than the other tribes surrounding them, and this is probably due to the practice of flattening the skulls of their offspring. They are too timid and nervous to be warlike, but when compelled to fight are dangerous, blood-thirsty, and wholly without mercy.

CHINESE INVENTIONS.

We hear a great deal of the inventive faculty of the Chinaman, but we venture to assert that his ingenuity has never been placed to more original account than in his inventions relating to the doings of European scientists. There is, according to the *Globe*, an illustrated Chinese journal, published at Shanghai, in which appear, from time to time, popular articles on the science of Europe. To show the kind of ideas they are spreading on the subject among the Chinese, we shall give one or two examples. In one number we have an illustration of the suicide of a Parisian aeronaut by means of a balloon. He is seated on a chair with his back to the window, through the open casements of which the balloon is partly seen with its bottom attached to his head, which he is in the act of cutting off with a monstrous curved knife. The balloon thus freed is understood to transport the head to a distance of 200 "lys" (a significant term), where it is afterwards found on a tree. In the meantime the body falls into the room, and thus closes the casements by two cords attached to its feet. A writing held in one hand informs the police that death was self-inflicted.

Another suicide is reported to bequeath his corse to feed the wild animals of a menagerie, and the Chinese writer goes on to say that for Europeans there is nothing contrary to nature in doing so, but that it would have been better if they had given themselves to a chemist, who would have extracted their best products and utilised them in making soap or grease. "European science has in fact arrived," he says, "at astonishing results; it wastes nothing; there is nothing which it does not utilise. An English chemist has found a way of extracting from the human body both soap and manure for agriculture." Then follow two realistic pictures representing the English manufactory where these processes are carried out, showing the workmen attending to the boiling vats and supplying the perfumes, the raw "material" lying in piles, and a number of young women close beside them engaged in packing the bars of soap.

The writer, however, is quite advanced in his views. "Humanity and our legislation," he goes on, "prohibit us (the Chinese) from raising the dead, and make us respect their repose. All violation of tombs is, by our laws, a crime punishable by death. Europeans consider the greatest public utility. Are they right? I affirm it. Agriculture will benefit by ground no longer necessary for burial; and for poor people no more expense for funerals, but rather a gain to their pockets by the sale of their dead; fields more fertile with an abundant manure; the price of soap considerably reduced." After this, from a Chinese public writer, we can hardly wonder at the prejudices of the masses against Europeans. The only foundation for it we know of was an estimate of the chemical products derivable from a dead body, published by a British chemist some years ago. Of course, it is just possible that the journalist, who translated these details, may have been guilty of some trifling errors due to the insufficiency of his knowledge of Chinese, or to his own inventive ingenuity.

THE MECHANISM OF THOUGHT.

Hitherto we have noticed the brain engaged in its more servile tasks, but *our* Familiar is a great deal more than a walking dictionary, a housemaid, a *valet de place*, or a barrel-organ man. He is a novelist who can spin more romances than Dumas, a dramatist who composes more plays than ever did Lope de Vega, a painter who excels equally well in figures, landscapes, cattle, marine scenes, smiling bits of *genre*, and the most terrific conceptions of horror and torture. Of course, like other artists, he can only reproduce, develop, and combine what he has actually experienced, or read, or heard of. But the enormous versatility and inexhaustible profusion with which he furnishes us with pen-pictures of our galleries, and new stories every night from his lending library, would be deemed the greatest of miracles, were it not the commonest of facts. A dull clod of a man, without an ounce of fancy in his conscious hours, lies down like a log at night, and lo! he has before him the green where he played as a child, and his long dead and half-forgotten mother smiles at him, and he hears her call him her "own little boy." What is it—*who* is it—that wove the tapestry of such thoughts on the walls of his dark soul? Addison says: "There is not a more painful act of the mind than that of invention. Yet in dreams it works with that care and activity that we are not sensible when the faculty is employed."

The small share occupied by the moral law in the dream world is a significant fact. It is the rarest thing possible for any check of conscience to be felt in a dream, even by persons whose waking hours are profoundly imbued with moral feeling. We commit in dreams acts for which we would weep tears of blood were they real, and yet we feel not the slightest remorse. If ever we do feel a sentiment like repentance in dreams, it is not the legitimate sequel to the crime we have previously imagined, but a wave of feeling rolled on from the real sentiment experienced in former hours of consciousness. Our dream-selves, like the Undines of the German folk-lore, have no souls, no responsibility, and no hereafter. Of course this observation does not touch the fact that a person who, in his conscious hours, has committed some dark deed may be haunted with its hideous shadow in his sleep. It is the imaginary acts of sleeping fancy that are devoid of moral character.

Whatever residue of truth may be found hereafter in the crucible wherein shall have been tried the marvels of spirit-rapping, mesmerism, and hypnotism; whatever revelation of forgotten facts or successful hits at secrets, is unquestionably due to the action of unconscious cerebration. The person reduced to a state of coma is liable to receive suggestions from without, and these suggestions and queries are answered by his unconscious brain out of whatever stores of memory it may retain. What a man *never* knew, that no magic has ever yet enabled him to tell; but what he has once known, and in his conscious hours has forgotten, *that*, on the contrary, is often recalled by the suggestive queries of the operator when he is in a state of hypnotism. A natural dream sometimes does as much.

Having now faintly traced the outline of the psychological facts illustrative of unconscious cerebration, it is time to turn to the brilliant physiological explanations of them afforded by Dr. Carpenter. We have seen what our brains can do without our consciousness; the way they do it is in this wise:

All parts of the nervous system appear to possess certain powers of automatic action. The spinal cord has for primary functions the performance of the motions of

respiration and deglutition. The automatic action of the sensory ganglia seems to be connected with movements of protection—such as the closing of the eyes to a flash of light—and their secondary use enables a man to shrink from dangers of collision before he has time for conscious escape. Finally, we arrive at the automatic action of the cerebrum; and here, Dr. Carpenter reminds us, that instead of being the centre of the whole system, in direct connection with the organs of sense and the muscular apparatus, the cerebrum is only "a superadded organ, the development of which seems to bear a pretty constant relation to the degree in which intelligence supersedes instinct as a spring of action."

Lastly, we come to the conclusions to be deduced from our investigation. We find the unconscious power credited with the following powers and faculties:—

1. It not only *remembers* as much as the conscious self can recall, but often much more. It is even doubtful whether it may not be capable, under certain conditions, of reproducing every impression ever made upon the senses during life.

2. It can *understand* what words or things are sought to be remembered, and hunt them up through some recondite process known only to itself.

3. It can *fancy* ten thousand fables with inexhaustible invention.

4. It can *perform* the task of mental arrangement and logical division of subjects.

5. It can tell the hour without a timepiece.

Let us be content with these ordinary and unmistakable exercises of unconscious cerebration, and leave aside all rare or questionable wonders of somnambulism or cognate states. We have memory, fancy, and understanding, at all events, as faculties exercised in full by the unconscious brain. Now it is obvious that it would be an unusual definition of the word "thought" which should debar us from applying it to the above phenomena, or compel us to say that we can remember, fancy, and understand without "thinking" of the things remembered, fancied, or understood. But who, or what, then, is it that accomplishes these confusedly mental functions? Two answers are given to the query, each of them, as we venture to think, erroneous. Büchner and his followers say: "It is our physical brains, and these brains are ourselves." And non-materialists say: "It is our conscious selves, which merely use our brains as their instruments." We think that all the foregoing study has gone to show that "we" are *not* remembering, *not* fancying, *not* understanding, what is being at the moment remembered, fancied, or understood. To say, then, that in such acts "we" are "using our brains as instruments," appears nothing but a servile and unmeaning adherence to the foregone conclusion that our brains are nothing else than the organs of will. It is absurd to call them so when we are concerned with phenomena, whose speciality is that the will has nothing to do with them. So far, then, we think the answer of the anti-materialist must be pronounced to be erroneous. The balance of evidence inclines to the materialist's doctrine that the brain itself performs the mental processes in question, and, to use Vogt's expression, "secretes thought" automatically and spontaneously. If the brain can work itself, have we any reason to believe that it ever works *also* under the guidance of something external to itself, which we may describe as the conscious self? It seems that this is precisely what the preceding facts have gone to prove, namely, that there are two kinds of actions of the brain—the one automatic, and the other subject to the will of the conscious self; just as the actions of a horse are, some of them spontaneous and some done under the compulsion of the rider. The first order of actions tends to indicate that the brain "secretes thought"; the second order shows that, beside that automatically working brain, there is another agency in the field, under whose control the brain performs a wholly different class of labours. Everywhere in the preceding pages we have traced the extraordinary separation which continually takes place between our conscious selves and the automatic action of the organ, which serves as our medium of communication with the outward world. We have seen, in a word, that we are not centaurs, but horsemen, astride on roadsters which can trot very well a little way when we drop the reins, and which, at other times, canter off without our permission.

When we place the phenomena of unconscious thought on one side, and over against them our conscious personality, we obtain a new and vivid sense of the separation, not to say the antithesis, which exist between the two, close as is their mutual independence. Not to talk about the distinction between object and subject, or to dwell on the absurdity that we, ourselves, are only the sum-total of a series of cerebrations, the recognition of the fact that our brains sometimes think without us, seems to enable us to view our connection with them in quite a new light. So long as our attention was given to conscious thought, and philosophers eagerly argued the question whether the soul did or did not sleep, or cease to think, it was easy to confound the organ of thought with the conscious self who was supposed to set it in action. But the moment we mass together for review the long array of the phenomena of unconscious cerebration, the case is altered: the severance becomes not only cogitable, but manifest. Admitting that our brains accomplish much without our conscious guidance, will help us to realise that our relation to them is of a variable, an intermittent, and a terminable kind. That such a conclusion, if reached, will have afforded us any direct argument, cannot be pretended. Though we may succeed in proving "that the brain can think without the conscious man," the great converse theorem, "that the conscious man can think without a brain," has as yet received no jot of direct evidence.

(*Concluded from last week.*)

THE CONNECTION BETWEEN EGYPT AND INDIA.

Among the facts which Mr. Hugh Neville cited at the International Congress of Orientalists to illustrate the theory of a philological connection between Egypt and India, was the use of rice-boats by the Goyi caste of Ceylon, which curiously recalls the oracle-boats of Egypt. Rice was still pounded for ceremonial festivals in these boats of stone or wood, while at the ruins of Amrajapura large ston boats were found of dates between B.C. 200 and A.D. 400, which were used to hold rice for the royal alms. The use of an image of Kâmadhenu, the celestial cow, among the Tamils of Southern India and Ceylon, must be regarded as a survival of Isis-worship. The image was used as a car at Mulaition, to support an image of Tântondiswara, or Siva, the self-created. The myth and custom were of obscure antiquity, the celestial cow typifying, in Southern Indian mythology, the fertility of Nature. The author did not assert that the affinity observed between Egypt and India came from the former place to the latter; for it might or might not date from a time and place before Isis-worship reached its great seat in Egypt.

THE MYSTERY OF SEVEN.

The critics of Theosophy are exercising themselves just now about the curiosities of the number seven. These critics do not believe in the potentiality of seven. On the other hand there is much curious evidence deduced. Mr. H. Grattan Guinness, F.R.G.S., gives it as his opinion that "The birth, growth, maturity, vital function . . . change, diseases, decay, and death of insects, reptiles, fishes, birds, mammals, and even man are more or less controlled by a law of completion in *weeks*," or *seven* days. And Dr. Layeock, writing in the *Lancet* on the "Periodicity of Vital Phenomena," after giving a number of illustrations from natural history, adds: "The facts I have briefly glanced at are general facts, and cannot happen day after day in so many millions of animals of every kind, from the larva or ovum of a minute insect up to man, at definite periods, from a mere chance or coincidence. . . . I think it impossible to come to any less general conclusion than this, that in animals changes occur every $3\frac{1}{2}$, 7, 14, 21, or 28 days, or at some definite number of weeks," or septenary cycles.

In this connection a fellow of the Theosophical Society sends the following interesting figures to a contemporary:— In the seventh month the human offspring becomes viable, after birth the seventh hour decides whether the child will live, in seven days the cord falls off, in twice seven days the eyes follow a light, in thrice seven days it turns the head, in seven months gets teeth, in twice seven months sits firmly, in thrice seven months begins to talk, in four times seven months walks strongly; after seven years teeth of the second set appear, after 14 years is the arrival of generative power, after 21 years the hair of manhood is complete, at 35 is the greatest strength, at 49 is the greatest discretion, and 70 is the natural end of life." (Dr. Wynn Westcott.)

In regard to pathology, Dr. Layeock, already quoted, says:—"Whatever type the fever may exhibit, there will be a paroxysm on the seventh day . . . the fourteenth will be remarkable as a day of amendment. . . ." (either cure or death taking place). "If the fourth (paroxysm) be severe, and the fifth less so, the disease will end at the seventh paroxysm, and . . . change for the better . . . will be seen on the fourteenth day." "Thus, materialistic science—medicine the most materialistic of all—applies our occult laws to diseases, studies natural history with its help, recognises its presence as a fact in nature, and yet must needs pooh-pooh the same archaic knowledge when claimed by the occultists. For if the mysterious septenary cycle is a law in Nature, *and it is one* as proven; if it is found controlling the evolution and involution (or death) in the realms of entomology, iethyology, and ornithology, as in the kingdom of the animal, mammalia, and man, why cannot it be present and acting in the Kosmos in general, in its natural (though occult) divisions of time, races, and mental development?" (Blavatsky—"Secret Doctrine," vol. ii., p. 623.) Dr. Stratton (*Edinburgh Medical and Surgical Journal*, Jan., 1843) states as a physiological and pathological fact that "in health the human pulse is more frequent in the morning than in the evening for six days out of seven, and that on the seventh day it is slower."

Here are a few curiosities of the number seven:—The body has seven obvious parts: head, chest, abdomen, two legs, and two arms. There are seven internal organs: stomach, liver, heart, lungs, spleen, and two kidneys. The head has seven openings: two eyes, two ears, two nostrils, and a mouth. There are seven (?) things seen: body, interval, magnitude, colour, motion, permanency. There are seven inflexions of the voice. The hand makes seven motions: up, down, right, left, before, behind, circular. In religions the number seven holds a prominent place. Here are a few examples out of hundreds or thousands. Hebrew: Seven days of creation, seven years of repentance, seven weeks of years and then the Jubilee, seven branches to the holy candlestick, seven dips in Jordan to cure leprosy, and so on. Christianity: Seven Churches of Asia, seven angels with trumpets, seven candlesticks of the holy places, seven seals, seven trumpets, seven kings, seven thousands slain, seven vials of wrath. There are seven essential events in the life of Christ, as related in the Apostles' Creed, viz., Conception, Birth, Crucifixion, Descent into Hell, Resurrection, Ascension, Second Coming; seven wounds: hands and feet by nails, side by spear, head by thorns, and back by stripes, and many other instances.

"If space permitted," says the Theosophist who is responsible for these details, "I could show the mystic seven running through the Gothic, Greek, Persian, Assyrian, and Chaldean religions, and those of India. After all, it is only the ignorant who can deny that "there is a harmony of numbers in all nature; in the force of gravity, in the planetary movements, in the laws of heat, light, electricity, and chemical affinity, in the forms of animals and plants, and in the perception of the mind." (*Medical Review*, July, 1844.)

We may add to these curiosities the seven remarks that the Bible relates were made by Christ on the Cross, and in Biblical times much mystery was attached to the symbol seven. Thus, Baalam, as an effectual test of the will of God, built seven altars and prepared seven oxen and seven rams for sacrifice. Job, referring to the effectual protection of Providence, says: "In seven troubles there shall be no evil touch thee," and again, "Wisdom hath hewn her seven pillars." Jacob, as a sign of perfect submission, bowed himself seven times before his brother. The sevenfold circuit of Jericho prior to its complete overthrow is another example. Naaman was commanded to bathe seven times in the Jordan as a prelude to his complete restoration to health. Sampson for full security was bound with seven bands. The Jewish Church has seven great holy days in each year. The Romish Church has seven sacraments. On the first appointment of deacons in the early Christian Church seven men of honest report were to be chosen. "How oft shall my brother sin against me, and I forgive him?" The question suggested seven times as the limit of endurance of wrong. The great apocalyptic angels were seven in number; and Ephesus, Smyrna, Pergamos, Thyatira, Sardis, Philadelphia, Laodicea were the seven Churches in Asia. In the same book we read of seven candlesticks, seven stars, seven trumpets, the seven spirits before the throne of God. Pharaoh in his dream saw seven oxen and seven ears of corn. On the seventh day of the seventh month a holy observance was ordained to the children of Israel, who feasted seven days and remained seven days in tents.

There are seven penitential psalms and seven deadly sins. The seven joys and the seven sorrows of the young mother are frequently represented in the art of the middle ages. The first series comprises the annunciation, the visitation, the nativity, the adoration of the kings, the presentation in the temple, the finding of Christ among the doctors in the temple, and the assumption. The seven sorrows are the prophecy of Simeon, the flight into Egypt, Christ missed in the temple, the betrayal of her son, the crucifixion, the deposition from the cross, and the ascension.

Other instances are the seven champions of Christendom: St. George of England, St. Andrew of Scotland, St. David of Wales, St. Patrick of Ireland, St. James of Spain, St.

Denys of France, and St. Anthony of Italy. We read, too, of the seven wonders of the ancient world. As a matter of fact there were eight; but in any list there is an "or" and not an "and" where they are enumerated. This verbal difference may seem trifling, but while the use of the latter word would make the total eight, the use of the former sacrifices one on the list to the desire to bring the total to the mystic number of perfection. We have also the seven wise men of Greece, while Shakespeare gives us the seven ages of man, from puling infancy to decrepit old age. The Hindoos believe in seven mansions of all created spirits, the earth being the lowest of these, while the seventh and highest is the seat of Brahma. The Moslem pilgrimage is at last consummated when seven circuits have been made round the sacred stone of Mecca. The astronomers tell us of seven greater planets, the alchemists dealt with seven metals, and we all of us recognise seven days in each week. With our forefathers the period of apprenticeship was seven years, and Jacob, for the love he bore to Rachel, was willing, in the Old World story, to serve Laban for as long. In the eyes of the law a stripling enters into manhood, with its contingent rights of suing and being sued, paying its own debts, and serving on a jury, when three times seven years have gone over his head; while the tenth seven marks the natural period and duration of human life.

We also have the seven bands of the spectrum. The usual term of penal servitude is seven, fourteen, or twenty-one years, and leases are based on the same calculation. In order to bring the mystery up to date, we should mention that SCIENCE SIFTINGS office closes at seven, and the advertising scale is seven guineas a page.

INOCULATING TOBACCO.

A surprising investigation which the American Department of Agriculture is conducting has to do with tobacco. An important part of the curing of tobacco is its fermentation, which occurs during the process known as "bulking." The leaves are packed closely together in large piles, and after awhile the mass heats, the tobacco being said to "sweat," and the aromatic compounds which contribute to its taste and odour are formed. These phenomena of fermentation are caused by bacteria. Now each sort of tobacco has its own kind of bacteria, which give it aroma and flavour incidentally to feeding upon it. Here comes in a wonderful discovery, for it has been ascertained by experiment that poor tobacco, when inoculated with the bacteria naturally belonging to fine tobacco, obtains the taste and quality of the latter. Thus by a simple operation it is easy to transform inferior leaves into first-class material for cigars.

Thus far the matter has not passed beyond the experimental stage. The trials were performed by propagating colonies of bacteria belonging to first-quality tobacco in beef tea, and then sprinkling the latter upon inferior leaves. After these leaves had been packed together and permitted to ferment they were found to have all the bouquet and other desirable qualities of the fine brand. So complete were the results that expert judges were unable to tell the difference. They can undoubtedly be secured on a large scale at a small cost, perhaps by merely spraying the poor tobacco with a decoction of a superior quality, transferring by this means the vegetable organisms whose assistance is desired. The notion that the difference between a British weed turned out in Whitechapel and an imported Havannah cigar is chiefly one of species in microbes is certainly calculated to be of interest to smokers.

SOMETHING ABOUT GOLD.

A peculiar characteristic of gold consists in its strong cohesive properties. If we take a sheet of gold foil and let it fall upon another it will be so firmly fixed that it cannot be removed. The pressure of the atmosphere upon the upper surface and the approximate vacuum between the two surfaces have some effect; but other experiments show that there is something beyond that—that the two pieces by thus coming easily together are actually welded. No other metallic surfaces thus brought together manifest any such cohesive powers. It is this peculiar property that makes gold so much preferable to any other metal for dentist's use. But for this peculiarity of gold, silver would no doubt be much used in dentistry as a cheaper material. But its adherence is quite limited, while the gold used in filling a tooth is actually welded together and fills the cavity just as completely as though it was melted and run into it. Two comparatively thin pieces of gold, with even surfaces, may be welded together by a very little pressure, applied by running the pieces between two rollers. Gold is thus welded to sheets of silver for the manufacture of cheap jewellery.

"Most people suppose," says an assayer, "that all gold is alike when refined, but this is not the case. An experienced man can tell at a glance from what part of the world a gold piece comes, and in some cases from what part of a particular gold district the metal was obtained. The Australian gold, for instance, is distinctly redder than the Californian, and this difference in colour is always perceptible, even when the gold is 1,000 fine. Again, the gold obtained from the placers is yellower than that which is taken directly from quartz. Why this should be the case is one of the mysteries of metallurgy, for the placer gold all comes from the veins. The Ural gold is the reddest found anywhere. Few people know the real colour of gold, as it is seldom seen unless heavily alloyed, which renders it redder than when pure. The purest coins ever made were the 50 dollar pieces that used to be common in California. Their coinage was abandoned for two reasons, first, because the loss by abrasion was so great, and, second, because the interior would be bored out and lead substituted, the difference in weight being too small to be readily noticed in so large a piece."

ACORNS AND CHESTNUTS AS FOOD.

At the recent Congress of German Naturalists and Physicians, the use of ammonia at 10 per cent. was recommended as a suitable agent for removing tannin and poisonous alkaloids. Horse chestnuts and acorns must be first pulverised. As leguminous plants contain no starch, it should be added to the purified product in the shape of ground acorns. The attempts at utilising horse chestnuts are not very satisfactory, as the loss of substance is very considerable. Fragments of the rind must also be removed, as they contain much tannin. Attempts to make horse chestnuts edible by roasting have not yielded good results; the sapotoxine is certainly destroyed, but the nuts cannot be eaten, as the fatty oil takes an unpleasant taste on roasting. The results recently obtained by Herr T. Solstein in removing the bitterness of acorns are noteworthy. In addition to the ammonia process he obtained good results by extracting the acorns six to eight times with cold soft water, and drying immediately afterwards. The loss by this method is still too great (25 per cent.), consequently Solstien prefers to make the acorns up into a paste with milk, and allow them to ferment. Acorn meal so prepared costs at most 4d. per kilo. ($2\frac{1}{5}$ lbs.).

SOCIAL SCIENCE.

THE INITIATIVE OF LOVE.

Much is to be considered and said seriously about the part of men and of women falling in love and in the conscious deliberate acts to which the grand passion leads, if it is to be more than merely a tearing of the heart to pieces by smothered struggles, like the writhings of the Titan under Ætna.

As to the falling in love, it is one of the strange facts of the world, showing how far custom may replace nature, that to love unwooed often has been held as unwomanly or unmaidenly as to confess the love unasked. Not to woo has been admitted on all hands to be the woman's part, and has been immemorially a point of maiden pride and shame. So great, indeed, is this persuasion that even the exact opposite of wooing has been made a point in the drawing of delicate women characters by many poets and story-tellers. To hide every hint of love, to pretend even coldness and indifferenee, to be inaccessible, discouraging, to "let conecalment like a worm i' the bud," etc.—"the proverb is something musty"—this has been the ideal of a woman's part set before sensitive young girls in song and story and drama. Of this some words hereafter. But at present why—even if a high feeling must be buried out of sight as if, as Shakspeare says of a beard on a coward, it were "nature's excrement" instead of nature's bloom and fruit-hiding petals—why, in the name of all that is simple, sincere, and natural, is it a fault or a shame for a woman to love unsought? If she may not speak or seek, may she not then feel? Is love such a thing in a woman that it is a shame to wake to it unless a man ask for it? Yet so have many women pretended in good stories and plays, and no doubt in real life. It is past doubting that many a woman has felt it would be, or unhappily was, a shame to give her love without being asked for it. But this is as up-side-down and topsy-turvy as if it were held a shame to live and breathe because we were not invited to be born. Why is an attachment of heart more to be shame-laden or held unwomanly (which is more than unhuman) than an attachment of mind? In other words, no more shame ought to be felt in loving a person unasked than in thinking of a subject or using one's reason in any way uninvited.

But if this be conceded, or whether it be or not, what is to be said of the unwritten, but most potent and immemorial canon that a woman must not speak her love, to invite a return of it or to carry it to its end, which is noble marriage? Let us not say end, but rather the second stage of its beginning, whence love goes onward towards its end like some noble curve whose apex is at infinity. Is this to be set down to nature? Are women made so? Or is it custom and education? And if the latter, is it a good custom and a natural education?

There is nothing more difficult than to discover the grain of nature in a bushel of customs. And, if it be found, it is of small account, for it is like a creature which has fed on the custom so long that its whole substance is but the customs a little transmuted. If the breath of heaven ever has blown through Turkish literature (of which we are ignorant wholly), we would hazard something that a question has been raised whether it be not by nature that women walk all veiled except the eyes, and that they hold it unseemly and immodest to be visible as to their faces to any man but husband, father, or brother. But we, who live with different customs, know well that such notions are glaring and vile offences against reality, fit "to give cleanly Nature a turn." We know that freedom and unconsciousness is the only exposition of modesty. We opine that the Turkish people, and all who are semi-affected like them, should be blown through with the blast of an old English nobleman's words to a wearisome prude: "Wettest thou not how much indelicacy there is in thy delicacy?" We will not reason as to whether it be contrary to womanly nature to speak of love, but she must wait the man's pleasure to speak to her first, or forego if never he speak. We assume it to be a custom merely; no matter how originating or how ancient, still only a custom. Then we ask, Is it a good custom, sound, salutary?

There is a story extant of a young girl who, to a young man courteously accompanying her home one evening, spoke thus, simply and quietly:

"My friend, I wish to say something to you very simply and truthfully, and I ask you not to think ill of me or be turned against me for it. It is this: I like you very, very much, and I honour you. I wish you would come to see me often and constantly, to try whether you may not like me. I know I have few attractions on slight acquaintanee or infrequent meeting. But I have a good, true heart, a mind not unstored by much good reading, and such virtues of character as I have been able to gain by daily sincere effort. These are the best attractions, if only there can be acquaintance. If you will come to see me steadily enough to know me you shall not be bound in the least. If you do not incline to me there will be no blame, no harm."

The young man, being high-minded, was touched and moved deeply. He said to her:

"You are a generous and brave girl. I will be as simple and truthful as you have been. I must tell you truly that I never have thought of you in the least. I have had the pleasure to pay you once or twice such little courtesies as I owe to all women. But my mind never has dwelt on you when away from you—not for a moment. There are two things, also, which you ought to think of. One is, that if I should visit you in that manner, and then, finding myself not drawn to you, cease my frequent calls, it would be given out either that I had trifled with you or that you had trifled with me, and either reputation would be very bad for you. The other consideration is, that as soon as it is observed that I visit you constantly all other young men will keep away from you. Have you considered these things?"

"I have considered," she said.

"And still you wish to have me come, and to leave me perfectly free?" he asked.

"I wish to have you come, and to leave you perfectly free," she answered quietly.

In such an act there is naught unwomanly or unmaidenly. It seems all dignity, serenity, simplicity, grace. It is possible for such an act to combine the strength of the sea, the firmness of the mountains, the freedom of the winds, with all the modest grace of a violet hiding in long grass and veiled with dew. What words could express the churl-soul and yokel-mind of a man moved by it only to aversion or embarrassment or amusement, or anything except respectful sympathy, unless indeed to a deep and tender reverence! What a cowardly sneak would be he who could betray such a womanly act to his male friends, or to other girls!

The story opens two questions. First, whether the initiative in love ought to be the right of both men and women, or only of one. Secondly, whether, if only of one, the right should belong to men or to women. One thing seems certain that the present method, which inflicts silence and concealment on women, on penalty of shame and derision, and gives to men alone the dignity and right of seeking to be loved—that this has some very heavy counts against it, and is very far indeed from being a happy and conspicuous success.

When we sum up the many sad marriages which have awaked ruddy, at least on one side, from fair dreams; the many marriages of convenience, which never had dreams; the many lonely women, and some lonely men, who accept their lot bravely, but are too round-souled and good to accept it willingly; the winks, quips, quirks, smirks, waggeries, innuendoes, jokes, sneers, with which love, elder maidenhood, bachelorhood are treated in common social talk, even often in places and company called elegant; the rankling and cruel jealousies, the flirtations, triflings, selfishness, and unfaithfulness of social life among the young; the mean, paltry, soul-shrinking arts, coquetries, devices, cunning, plots, allurements, to which women resort in lieu of the dignity of direct power and right—these amass to a heavy reckoning for the present system. Some of them wholly, perhaps all in part, may lie in the atavism of that human nature which always stands trembling, and so will for many a long stretch yet, between the glory of its destiny and the meanness of its history. But all the same it is true that the present system has little to say for itself if judged by its results. There is too much evil mixed with the good, and some of the evil at least, and some of the worst of it, fairly may be traced to the stupid and unnatural rule which forbids a woman to seek her own love-life simply and plainly.

It is, however, no little question whether both men and women should have the right of the initiative in love—at least, whether it should be so habitually, or by common custom, without any restraint of sentiment. Perhaps something might be lost by such a common participation—something delicate, tender, poetical, valuable. There seem to be some reasons why it were better for only one to have the initiative by custom, with the strong sanction of usage, prestige, sentiment, but not with the invariableness and tyranny which marks the present allotment. Of these reasons, the chief seems to be the mystery, delicacy, romance, honour, and special character thrown around love by having the general provinces of men and women different and defined in the initiative. It may be that an equal, unrestrained, similar and open access to each other for initiative or confession of love might wear away much bloom, wonder, sancity, which is preserved by the difference of relation of the two to the beginning and avowal. The sexes are so different, while such a unity, that this no more should be overlooked than their essential unity in the midst of their so great differences. It may well be that it is for the harmony, delicacy, joy, mystery, and beauty of love that the differences of the sexes should be recognised by a different relation to the initiative of the relation. It may be that an inexpressible, indefinable but very valuable sentiment may depend on some patience, anxiety, canonical delicacy, conventional reserve, on the one side, to meet action, judgment, choice, decision, initiation, on the other. Where all may advance equally and in the same way, nothing is hidden; and without some reserve there can be no tenderness. Where all may explain equally and without hesitation, there can be no drapery, no veils; and where there is no mystery or wonder, there will be a lack of joy. A seeker and a sought, a proposer and a considerer, a leader and a follower, a petitioner and a giver, may be a fairer sight, and more wholesome to love, than two who may challenge each other equally, who, therefore, have no defined duties or sweet reciprocities regarding each other, who, perhaps, may delay for each other—a stupid situation—or may strive to get the start of each other—an utterly demeaning and undoing rivalry—or may scramble to forestall others—a profane haste which often is bad enough now.

But if this be true, it is still a question whether the initiative should rest with men or with women. We are far from saying now that there are no good reasons why it should rest with men. We only insist on two points: (1) That the immemorial vesting of this right in men, the physically stronger and more aggressive, is no proof whatever of the wisdom of such an allotment, or necessarily means anything more than that men seized it when savage conditions gave muscle a greater value than gentle intelligence, and that its continuance now is but a survival of a barbaric usurpation; (2) We insist that its transfer to women would inflict no shock whatever on womanly nature as truly it is, and that there is nothing in the least destructive of maidenly reserve or womanly beauty in taking the initiative in love. We suspect that the boldness, haughtiness, vanity, and pretension of the lordly sex would be shorn very much; and we mistake much if women would be spoiled by the right and power, so as to queen it on the strength thereof, as commonly men now strut and lord it on their prerogative. "There is not so impudent a thing in nature," says Congreve, "as the saucy look of an assured man, confident of success." It is possible that to make the vaunting, declaratory, and—as we men ourselves say, bless us!—the blundering sex, wait to be chosen by that half of humanity to which commonly we allow more devout love and purer intuition, would work a new modesty in men and in a new excellence in love quite surprising.

VARIATIONS OF THE COMPASS.

Why the magnetic needle points northward has never been satisfactorily determined, but what perplexes and puzzles scientists most is its persistent variations. By observations in Paris it was found that in 1681 the magnetic needle varied 2 degs. and 30 mins. to the west; in 1865, less than 200 years later, 18 degs. and 30 mins. to the west. In London, between 1580 and 1692, the needle varied from 10 degs. 15 mins. east to 6 degs. west. It does not point due north except in a few localities, and at no place does it continue to point with a given angular distance from the north for any stated length of time. In many places it changes secularly, annually, diurnally, and hourly, and is, besides, further subject to fluctuations reducible to no method of tabulation. In the vicinity of iron in any shape, or of magnetic sands, it is deflected toward the material attracting it. The needle has been known to vary 5 degs. in a distance of one mile, and 1 deg. and 30 mins. in two hours when left stationary in a certain locality.

HELPFUL HINTS:

Being Answers to Correspondents.

Questions to which answers are desired in this column must NOT *be marked "Science Queries and Answers."*

W. H. WHITE.—The cheapest book we know of in which the sextant is described is one by Heather on Surveying Instruments, to be obtained from Messrs. Batsford, of 52, High Holborn, price 1s. 6d., post free.

G. RICKETT.—Queries and Answers may be inclosed in the same envelope. The name and address of the sender must appear on each sheet. We are simply inundated with queries. That which you send is, however, among those which we have placed on file. We endeavour to deal with these queries in the order of their interest, consistently with due variety in the subjects treated.

E. A. KENNEDY.—As seen from the earth, the sun has an apparent motion of evolution in the celestial sphere; and the great circle, which it thus traces is described as the ecliptic. The two points at which the ecliptic intersects an imaginary prolongation of the equator of the earth are known as equinoxes; at one of these, where the arrival of the sun in spring-time causes equality of day and night throughout the world, is situated the first point of Aries. The number of hours that

elapses between the time at which the first of Aries passes the meridian of an observer, and that at which a comet passes the same meridian, measures the "right ascension" of the comet. The "north polar distance" is the angle between the comet and the earth's north pole produced. You should look for the comet in the S.E. As to your own astronomical theories, they are very interesting and suggestive; but we cannot find space for them. We are overwhelmed with offers of contributions, from which we can select only such as commend themselves distinctly to our own judgment. Your views, although so ingenious, are hardly to be described as "orthodox," Moreover, "prophetic dreaming" is one of those articles of faith, which we regard with unmitigated scepticism.

SYDNEY H. MARSHALL.—The diameters of *Phobos* and *Deimos*, the two satellites of Mars, are supposed to be about 7 and 6 miles respectively.

ED. P. SMITH.—To obtain very large crystals is a work of months. Employ a saturated solution, half filling a teacup with it, and replenishing with more of the solution as evaporation and crystallisation take place. If, to save time, you must evaporate by artificial heat, a spirit lamp will serve your purpose very well.

SOCIOLOGIST.—There was nothing in "The Martial Spirit" at variance with the views expressed in your letter. You are debating a different aspect of the question. We only referred to the fighting instinct in man and its effect on the development of races. Although we may dislike war we cannot but admire courage, and it is undoubtedly what the essayist meant when he observed that the "fightingest parts of the Bible are the ones that he reads with most interest." Your letter is too long for publication, but accept our thanks for sending it.

DANIEL.—The effect of alcohol in clogging and depressing the brain before reciting and acting, and breaking the voice, is entirely a matter of personal experience, as it is dependent on the physical power of resistance, which varies, of course, in individuals. Alcohol is an excitant, but its stimulating effects are followed by corresponding depression; the result of putting on too much steam. It stands to reason that all unusual consumption of energy—such as undue excitement—must be compensated sooner or later. Hence the depression to which you refer. Some individuals with more physical strength than yourself might resist the after effect for a longer period, or even entirely. The effect of a pipe in clearing the mind and making the brain active would probably be felt only by excitable persons, as it is a sedative and would allay the excitement, and thus conduce to the state of coolness necessary for collecting the thoughts. Thus while alcohol might assist a phlegmatic individual to brain activity, tobacco might be equally useful to an excitable temperament. Read the second part of the "Mechanism of Thought." You have not fully grasped the drift of the first part.

R. HALL.—Our reply last week was misprinted. The answer should have been five thousand million cubic miles as the cubic contents of the moon.

L. J. H.—One could scarcely imagine a more cruel and offensive method of catching flies than that of gluing their living bodies to an adhesive surface. We should not suppose that you would wish to adopt this plan in preference to others less repulsive. In reply to your question, however, we may inform you that the "catch 'em alive" fly papers are coated with linseed oil, which has been submitted to prolonged boiling in the presence of an excess of yellow rosin. The rosin is, to some extent, dissolved by the linseed oil, resulting in the production of a viscid paste.

AIR WAVE.—The "phonograph" you mention is supplied by Messrs. W. and F. Hamley, of 231, High Holborn, W.C.

A FREETHINKER.—Edison's phonograph is not upon the market. We recommend you to communicate with Messrs. W. and F. Hamley, of 231, High Holborn, W.C.

For "SALE AND EXCHANGE" Column see Page 368.

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SCIENCE NEWS AND NOTES.

"Any human being, however humble or liable to error, may render an essential service to society by making, through a whole lifetime, a steady, uncompromising, dispassionate declaration of his convictions as they are matured."—HARRIET MARTINEAU.

A Child's Future may be Gauged

by many physical developments to be seen at birth or soon after. We must not be understood, however, to espouse the laying down of any arbitrary rule on the subject. No matter what physical conditions are indicated at birth, they may be influenced by the after life, and either innate good or evil may be exaggerated, minimised, or, in some instances, eliminated altogether. Nevertheless, the conditions existing at birth must affect the after life to a certain extent, or else what becomes of the laws of heredity? Dr. Francis Warner, of the London Hospital, tells us the proper standard of the normal head in a well-developed child of good potentiality, at nine months, is 17·5 inches circumference, at twelve months 19 inches, at seven years 20 to 21 inches. This is a very high standard of the normal, too high if deviations are to be considered as diseased, although after three years 19 inches cranial circumference is too small. Dr. Warner's observations are the result of examining 50,000 children. His figures are, therefore, very reliable.

Small Heads are More Common with Girls

than with boys. This is, however, contrary to the usual rule. Nevertheless, if a small head be the only defect, mental faculty may be average, but the child usually remains thin and delicate. Such cases in after life may undertake good work and do it, but are more liable than others to exhaustion, migrame, and breakdown of the nervous system. Delicacy in childhood is the rule with small-headed children. There are various other defects in children but they are much too complicated to be followed by the lay mind, and the symptoms cannot always be observed by the uneducated eye. Suffice it to say that all other defects are more prevalent with boys than girls.

The Defects of Expression

in children are far more numerous than would be supposed. Dr. Warner mentions that horizontal creases are formed on the face through the frontal muscles overacting. The sign may appear in children at any age, and is usually most marked when they are least occupied. There is also knitting of the eyebrows, and the skin of the lower eyelid may be found relaxed, puffy, and baggs forward. The sign often accompanies fatigue and recurrent headaches. Children are usually dull at lessons when the eye movements are defective. The eyes may wander and fix badly, or they may be too immobile, so that the child follows a moving object by turning the head, not by moving the eye. Ill-balanced hands are another feature to be noticed. In the weak type the wrists and fingers fall into moderate flexion, and in the nervous type there is flexion of the wrist and over-extension of the digits. The former type is common in weak children, the latter in those who are irritable, nervous, over-mobile. Other bad signs are finger twitches, abnormal curvature of the spine or bones, head balance not symmetrical, defective response in action, defective speech, mouth open, grinning, blinking of the eyes, and tremor. The point to be considered in all the signs we have referred to, apart from any consideration of marred beauty, is the fact that they are all more or less indications of nerve weakness, much to be feared in after life, and which may affect the future of the subject in no immaterial degree if not counteracted in childhood.

A Relic of Some Great Flood

or other terrestrial catastrophe, was recently found in Mashonaland, South Africa, by the Rev. Owen Watkins, who is prospecting there on behalf of the Wesleyan Missionary Society. In a recent letter he says he is presumably the first white man to see the Mount of Footprints, which he thus describes:—At last we came to one large mount of rocks on the top of the hills. Here are thousands of impressions on the granite rock. Hundreds of human footsteps, thousands of footprints of animals—lions, jackals, wolves, and antelopes. On the top of the mount the appearance is as if a crowd of animals and men had rushed together in fright. At whatever period these footprints were made, it must have been before the outer surface of the rock had hardened. The distance from where the footprints begin, to where they culminate on the mount, is 200 yards.

The Solubility of Glass in Water

was recently the subject of experiment by a German investigator who had determined the electrical relations of the dissolving action. A note received from Dr. T. Drinkwater, Lecturer on Chemistry in the Edinburgh Medical School, shows that the investigation alluded to is by no means a new one. In 1886 Dr. Drinkwater read a paper on the subject before the Edinburgh Association of Science and Art. His attention was drawn to the matter by a firm in

Leith, whose boiler-gauges were constantly giving way. The fault was believed to lie with the glass, and Dr. Drinkwater was accordingly requested to analyse the gauges to determine, if possible, the cause of the flaws and failures. In a certain high pressure boiler the glass of the gauge was worn away to the thinness of a sixpence after fourteen days' use. It was found that the glass was of good quality, but Dr. Drinkwater noted that the alkaline materials used for softening the water dissolved glass rapidly. The water alone, under great pressure, also exhibited a powerful solvent effect. Boiling glass in water, in alkali, and in acid was also tried with the view of determining the different effects produced. The water alone and the alkali were found to exercise a dissolving action, while the action had little or no effect. Dr. Andrew Wilson considers that these experiments may show that possibly the solvent action so powerfully induced by alkaline solutions may depend less on electrical than on purely chemical conditions; but, of course, it is hard, or impossible, to say where purely chemical action ends and electrical action begins—the two things indeed are often interchangeable terms in the physical series.

Mimicry in the Lower Animals

almost amounts to a function, doubtless given by nature for self-protection. Darwin points out that many insects, birds, lizards, and serpents have this quality in a remarkable degree, and it enables them to assume so closely the colour of their surroundings that they are overlooked by other species that prey on them. Thus certain South American butterflies imitate with exactness the colours of another and different family of these insects. The latter are strong-smelling, and are protected by their odour from falling a prey to birds, which reject the chances of an unsavoury meal. The imitating butterflies are odourless, and perfectly fitted for bird food, but the birds fight shy of them as of the strong-smelling insects, and the odourless group secures protection through its mimetic resemblance to the other family. So, also, we find the stick insects and the leaf insects imitating in a very remarkable fashion the appearances of dried twigs and of leaves respectively. A recently reported case is that of a certain insect (*Athalia*) allied to the saw-flies, wasps, and bees, and of another insect belonging to the fly order. At rest it is impossible to say which is which. The Athalia is disliked by birds because of its unpleasant smell; hence the odourless fly secures protection by its cultivation of the features of its unpleasant and unrelated neighbour.

The Possibility of Photographing Ball Lightning

was recently discussed at the Camera Club, and an alleged case of the photographing of ball lightning was brought up, and an alleged photograph taken at Newcastle of globular lightning was projected in magnified form upon the screen by means of the optical lantern. It represented a perfectly circular luminous disc, with flame-like protuberances here and there. The *Engineer* hopes that close inquiries will be made as to the trustworthiness of this photograph; but taking the best view of the case, many such will have to be taken by different persons before the scientific world can indorse the genuineness of such alleged feats. Meanwhile we may raise one technical objection, which seems to tell strongly against its being a photograph of globular lightning. Ordinary photographs of lightning are taken at night by pointing the camera to the dark sky or cloud, with the lens uncovered, and with the sensitive plate also uncovered, for, as the lightning is quicker than dark shutters, or the conveyance of nervous force to the fingers by the action of the brain, instantaneous mechanical shutters would be of no use. When one or several flashes have occurred within the field of view, the operator caps the lens and puts in a fresh plate ready for the next exposure. As no shutter is used, how is it that a travelling lightning ball comes out sharp in the picture, instead of making a broad band from the top to the bottom of the plate? It can scarcely be argued that the ball stood still to be photographed, or that it was travelling horizontally straight in the direction of the lens; in the latter case it is probable that neither the plate nor the photographer would have been left to bear their testimony. Although ball lightning is rarely seen, its reality is fully admitted by men of science. The balls usually appear to be about a foot in diameter, and are of low illuminating power; it has been calculated that in some instances they have taken ten seconds to fall from the cloud to the earth, and then a violent explosion usually occurs; sometimes they have been seen to rebound from the ground. A high authority has stated that they have never been artificially imitated by experimenters, but many years ago the late Mr. Cromwell Varley showed us some small luminous masses, about the size of pins' heads, travelling about some of his electrical apparatus—the nature of which apparatus we forget—and expressed his opinion that they were of the same nature as ball lightning. He was noted for the originality of his inventions and apparatus, for he was not a scientific plodder who travelled much in the grooves laid down by other men. Perhaps some of his surviving relatives may be able to give information about the apparatus just mentioned. The *Engineer* points out that when a lightning ball takes several seconds to travel, it might be easy to give a shutter exposure on it, but then it must be remembered that the luminosity of these balls is only about that of red hot iron.

The Tools Employed by the Egyptians

to hew, carve, and polish the immense masses of the hardest stone which are found in the valley of the Nile, has always been food for speculation by the curious. The question has been frequently asked and frequently answered in a more or less unsatisfactory manner, and in no instance has the explanation been supported by fact. The numerous tools found in Egypt have been, with only two or three exceptions, of soft bronze. The few exceptions are of soft iron, but not a scrap of steel is there among the lot. It has been surmised, without proof, that the Egyptians had a way of tempering bronze, although no tempered bronze has been found, and no mode of tempering bronze is known to modern metallurgists. It has been daringly imagined that the bronze tools were tipped with diamond or corundum; but there are no diamonds in Egypt, and no corundum tipped tools have been found. It has also been alleged in opposition to this theory that bronze is unfit for being used as a stock to support a diamond or corundum tip, as it would get jammed in any hole into which it was inserted. Not one of the answers can be accepted as satisfactory, and the clearing up of the mystery has yet to be looked for.

Is the Sun an Immense Electric Light?

This remarkable hypothesis has occurred to the mind of a Frenchman, M. Stas, and he has submitted a paper in which he has, to his own satisfaction, demonstrated the truth of his theory. The statement suggests a few queries. If the sun be an electric light, where is the dynamo or battery by which it is maintained, and whence comes the power which actuates the one or the other? If it be an arc light, where the poles between which it plays? If it be an incandescent light, what is the medium which is raised to a sufficient heat, and

where does the current come from, and where does it go to? And, finally, is the solar spectrum that of an electric light? We have not seen the paper referred to, but it may be that M. Stas answers by anticipation the queries set forth. Presumably, intense friction with the ether particles is the basis of the hypothesis.

The Cause of Coughing

was very ingeniously explained, the other day, in a popular science paper, by Dr. J. E. Taylor, who drew a picture of the relationship between "the builders of great continents and the million-numbered cilia (hair-like appendages) that line a man's throat." It was shown, however, how all came within the natural history of minute animals, for if one of these specks in the throat is separated from its fellows, it will be observed to move like an amœba, which it resembles in its essential elements. The relationship these have towards other animals is not difficlut to trace.

People Who Think Flies no Good,

and want to know why they are made, should, Dr. Taylor thinks, begin nearer home and ask why they themselves were made, if they were not useful. Insects in their multitude are great scavengers of the world, but when a fly has died it has to be "undone," the materials of an "undone fly" are needed by the world for the continuance of life. About 15,000 million human inhabitants are in a world only about 8,000 miles in diameter, while a considerable part even of that space is uninhabitable, or inhabitable only by highly specialised life. There is an enormous and apparently exhaustive demand made on the soil, and we must remember how similar in their requirements are all the beginnings of life, both vegetable and animal. Until recently there was a rude division, but now the beginnings of life, the lowest microscopic organisms are known under the common term of protista. Flies are rich in nitrogen, and nature says to the fly, "You have done with it—I want it," and the fly is dissolved for the benefit of the living. Much entertaining matter may be made out of the life history of a fly.

The Ceratodus or Lungfish

of Queensland, is thus described by Professor Spencer, of Melbourne University :—"It lives only in the Burnett and Mary rivers in Queensland, and belongs to a small group intermediate between fishes on one hand and amphibia on the other. In it the swimming bladder of ordinary fishes has been modified so as to perform the part of a lung—that is to say, an apparatus capable of allowing the fish to breathe air. The ceratodus does not appear to leave the water, but it rises above the surface and takes in air while making a feeble spouting noise. The lung is of great service to it during the wet season, when the water of the flooded rivers is thick with sand. It feeds on vegetable matter, for example, the seeds of gum trees which have fallen into the water. The protopterus of Africa is allied to the ceratodus, but it leaves the water, and in the dry season makes for itself a covering or cocoon of mud in which it lives, breathing the air with its lung."

The Loss of Magnetism in Permanent Magnets

which are exposed to the temperature of boiling water, is shown by the researches of Stronhal and Barnes to be from 28 to 67 per cent. But, if after such treatment these magnets are again magnetised, they lose on being once more subjected to the temperature of boiling water only a very small percentage of their magnetism. It appears also that a magnet which has been subjected to this demagnetisation and remagnetisation is less susceptible of deterioration under the influence of mechanical shock. In fact, one magnet, after suffering repeated shocks, only lost a small fraction of its magnetism. The results of these experiments suggest the possibility of obtaining powerful magnets of great constancy and durability by a simple and economical process.

Lakes in Which Dead Bodies Never Rise

are often a cause of wonder to the inquiring and awe to the superstitious. It will, however, be found that in all these cases the low temperature of the water is the only reason for the phenomenon. The body of a drowned man rises because of animal decomposition, and the formation of gases, which render the specific gravity of the body less. Lake Tahoe, at the eastern base of the Sierra Nevada mountains, for instance, concerning which the local superstition is very great, is 35 miles long, 15 wide, and 6,250 feet above the sea. It is fed by snow water and mountain springs, and even on the hottest midsummer day the temperature a foot beneath the surface is very slightly above 32 deg. Fahrenheit. There is no chance, therefore, for decomposition to set in, and so the bodies of the drowned do not come to the surface. They are sometimes recovered, for the water is as clear as crystal; but when the drowning takes place in those parts of the lake where the water is from 1,200 to 1,500 feet deep the body sinks from view and is for ever lost. The same phenomenon is observable in several of the lakes of Norway, Germany, Switzerland, Northern Russia, and Siberia, and in every case is due to the same cause, though local superstitions have in several places accredited malign influences with the disappearance of bodies.

Light for Photographers

formed the subject of a short article in our issue of 19th inst., and in it we suggested a mode by which the photographer might ascertain the period when the light will be most favourable for work. The method described is by means of a watch—for full particulars our readers can refer to the article—but the difficulty of finding the north point rather detracted from its utility. A correspondent, Mr. C. Batstone, now writes that this difficulty may be easily overcome by "Noting the time of observation by watch, taking half this—that is supposing it to be 4, this would be 2—and directing it (the 2) to the sun, the 6 on dial will then point north. Of course, not quite truly, on account of equation of time, but for this purpose accurately enough. By reading the half time from the 6 on dial—to the left before 12 and to the right after noon—the double observation can be made at once."

A Curious Foundation,

which is well worth the consideration of our engineers, was recently employed with much success. The building to be supported was a low wooden one on a swampy soil, and it was proposed to use it for the storage of machinery. Casks were set in holes in the ground along the line of post, and were filled to the depth of about one foot with iron turnings. The posts were placed in the cask, which were then filled with iron turnings compactly rammed in place. A solution of salt and water was slowly poured over the turnings, under the action of which they solidified into a hard mass. The heat of the oxidation of the iron was so great that the posts were charred. This also served to act as a preservative, and to that extent, the iron turnings are probably superior to concrete under similar conditions.

GLEANINGS OF THE GLOBE.

Nails have been observed to grow on the stumps of fingers that have been amputated.

The theory has been propounded by Mr. Henry Wilde, F.R.S., that the core of the earth is fluid and magnetic, and lies behind the crust, which is also magnetic.

It is said that the human mouth is surely but steadily moving toward the left of the face, owing to the tendency to chew with the teeth of the left jaw.

Those who have lost their voices through injury or disease, may now have the damage repaired by artificial means. Many are said to derive benefit from "artificial voices."

The pale green carnation is dyed by plunging the stem in an aqueous solution of the aniline dye called malachite green. The dye ascends to the petals by capillary attraction, and at the end of twelve hours they are well tinged with green.

The chief element in the composition of a tear is water, but with water is associated minute proportions of salt, soda, phosphate of lime, phosphate of soda, and mucus, and when seen under a microscope, a tear after evaporation looks like a very small fish bone, owing to the salines forming themselves into lengthened crosslines.

A typewriter for musical composers, which, it is claimed will greatly facilitate operations and secure very satisfactory results, has been designed by an American. The copy which it makes can be photographed and a plate reproduced for printing, which is said to be superior to plates made in the ordinary way.

Think of a mining enterprise conducted by soaring aloft in a balloon. There are many ore-producing ledges on the precipitous sides of hills in the Rocky Mountains. These ledges are so lofty as to be inaccessible by ordinary methods; therefore, Mr. S. C. Rees, an experienced miner, proposes to reach them by means of an anchored balloon. This will enable him to secure footholds on the ledges, and make entrances through the sides of the precipitous hills.

It is well known that horses can hear deep sounds which we cannot. For days previous to the earthquake in the Riviera, the horses there showed every symptom of abject fear, which continued without any change of character till the fury of the convulsion broke forth. But not till a few seconds before the earth began to quake did human beings hear any sounds, while it is extremely probable that the horses heard the subterranean noises for two or three days previously.

There is a story about Darwin and the snakes. He used to go into the London Zoological Gardens and, standing by the glass case containing the cobra de capello, put his forehead against the glass while the cobra struck out at him. The glass was between them; Darwin's mind was perfectly convinced as to the inability of the snake to harm him; yet he would always dodge. Time after time he tried it, his will and reason keeping him there, his instinct making him dodge. The instinct was stronger than both will and reason.

One of the curiosities of America is the burning mine at Summit Hill, near Mauch Chunk, Pensylvania. It has been on fire since 1858, and no scheme nor device, though hundreds have been tried, has been able to suppress the flames. Nothing can be seen but a hill from which steam and gas escape at a thousand different points. The rocks are so hot that sometimes it is impossible to touch them without pain, and all vegetation on the mountain has long since disappeared. How deep the fire extends there are no means of knowing, but it certainly must be a miniature volcano, and millions of tons of coal since the fire first started have thus been slowly consumed.

Blonde hair is finer than that of any other colour. By actual count it has been ascertained that 400 hair to the square inch grow upon the head of a blonde beauty. The brown comes next with 350, then comes the black with 325, and the red with 250 to 260. After counting the hairs growing on an inch square it has been estimated that on the head of a blonde there will be about 140,000 hairs, while a brown suit of tresses will have 100,000, black 102,000, and a red 90,000. It may not be true that in the Scriptural sense one's hairs are all numbered, but they may be estimated with some degree of approximation to the truth, and the result is certainly one of the most curious facts of science.

Dogs, it is said, howl when music is played because the sensation is unpleasant to them. A correspondent thinks this must be a mistake. Instances are common of dogs being affected almost to tears—if such an expression is allowable in the case of dogs—by the sound of a violin or piano, and yet in no case, although the door may be open, has the dog made any attempt to escape. The sounds may not be altogether pleasant, and the dog's howling may be an expression of his sympathy with the character of the music played, but it certainly does not affect him unfavourably, or he would leave.

The durability of iron railway bridges is being investigated carefully by several of the European Governments as a consequence of the many late serious bridge disasters. The result of extended English and German investigation seems to show that under the most favourable circumstances bridges are not safe for a period exceeding 75 years; and under certain conditions, their life is much shorter. The method of manufacture is of the least importance in this estimate of durability. The effect of a more or less heavy traffic upon the fibre resistance in the materials of construction plays the important part, and the pounding under train motion and the vibration due to rolling loads wear out the bridge.

A queer submarine boat, for which the inventor claims some wonderful things, yet to be attempted, has been launched at the Detroit, U.S.A., boat works. The propellers are reversible and placed amidships. They are intended to regulate the immersion of the boat and propel it. The craft is 40 feet in length, 9 feet in width, and 14 feet in depth. It is elliptical in shape, and it draws eight feet in water. A sort of prepared canvas is stretched over the oak frames, and that is covered with one-inch plank. The boat will withstand a pressure of 86 feet of water. Air is stored at a pressure of 15 pounds, and sufficient can be stored to last three men for several hours while the boat is submerged. An observing tower two feet in height is on top of the boat.

SCIENCE QUERIES AND ANSWERS.

A prize of two shillings and sixpence will be awarded for every interesting question asked by our readers and published in this column, and five shillings will be given for every answer published. In all cases when a similar question or reply is sent in by two or more correspondents, the award will be given to the one whose letter is first opened, provided the subject is properly treated. Questions asked by correspondents and not replied to by our readers, may, if of sufficient interest, be dealt with Editorially.

Rules for Competitors.—(1) Only one question may be sent each week, but any number may be answered. (2) Write on one side of the paper only. (3) Envelopes must be marked "Science Queries and Answers," and must arrive not later than the Monday following date of publication.

The following are Answers to Queries published in No. 22.

55.—What is the fastest motion that can be given to a mass of matter by artificial means?

The motion of a rifle bullet is commonly cited as the most rapid that is practically attainable. The velocity of such bullets has been measured as over 2,200 feet per second. Supposing the rifle to be fired from an express train, the resultant speed of the bullet might reach about 2,300 feet per second—a rate of motion by which a region of perfect vacuum would be formed in rear of the projectile.

56.—What is the chemical constitution of the brain?

The brain is described as a mobile penetrable colloid septum, exhibiting remarkable powers of chemical combination. Among a great variety of highly complicated organic compounds it contains cholesterin, lecithin, and cerebrin, in considerable proportions. Albuminous substances are also present, besides from 80 to 90 per cent. of water. This chemically associated water may be supposed to engender great mobility of the organic particles, within certain limits of movement. Some of the constituents of brain matter are precipitable from aqueous solution by nearly every known reagent, including acids, bases, and salts. It is not surprising, therefore, that many inorganic principles, derived from the blood are retained by virtue of the combinational powers of the brain. These inorganic substances comprise sulphuric, hydrochloric, phosphoric, and carbonic acids, together with potassium, copper, iron, and other metals.

57.—How can eclipses of the moon be predicted, without the aid of elaborate calculations or the nautical almanack?

Sir Robert Ball states that, by observing all the eclipses of the moon during rather more than eighteen years, those which will occur in the future can be predicted for a long time to come. It is only necessary to remember that every such eclipse is followed by one nearly similar to it after an interval of 6,585⅓ days.

58.—What causes the ruddy colour of a sunset?

This colour is explained upon optical principles as being due to the earth's atmosphere, and a result of the presence of minute suspended particles of dust, water, and ice. The redness increases as the sun sinks to the horizon, because of the increasing thickness of the atmospheric layer through which the light must pass. Volcanic eruptions, by which additional dust is precipitated in the air, increase the redness of the setting sun. Direct proof of the assertion made is also furnished by the ruddy light, or "earth shine," seen upon the moon when it is totally eclipsed. This "earth shine" is simply the sun's light, bent or refracted inwards by our atmosphere into the shadow of the earth. It is of a duskier red than any sunset, because of the much greater thickness of the atmospheric layer involved.

59.—What was the first application of instruments to the purpose of astronomical observation?

Professor Ball considers that probably the first such application was that of a stick used in measuring the length of the shadow cast by the sun. The variations in the length of this shadow, with its periodical maxima and minima, would furnish information in the simplest manner as to the apparent movements of the sun.

60.—In what way can the colourless serum be separated from fresh blood, and what physical characteristics does it present?

Blood, as it flows from the blood-vessels, is collected in stout test-tubes, provided with indiarubber stoppers. When the blood has coagulated, the tubes are fixed on a turn-table, so that the stoppers are directed centrally. The turn-table is then made to revolve with great velocity for about half-an-hour, after which time the clot is found to have retracted itself to the peripheral ends of the tubes, leaving clear serum in the ends of the tubes directed towards the centre of the rotating disc. Serum is a liquid containing about ten per cent. of solid matter in solution. Taken from the lower animals it is found, in the case of the ox, to be of a very red amber tint, in the horse amber coloured, in the dog somewhat yellowish, and in the rabbit perfectly clear. Human serum exhibits changes in its appearance, with slight changes in the state of the health and nutrition. Thus, in the case of a man who had fasted for eighteen hours, the serum was of an amber yellow colour, like very light sherry wine, and quite transparent. Two hours after a full meal the serum was found to have become turbid, and, after six hours longer, was of the colour of water gruel, and quite opaque. Such opacity of the serum is due to the presence in it of finely divided fat, and is the invariable result of an abundant fatty diet. Human serum is rather heavier than water, and possesses a slightly alkaline reaction.

QUERIES.

Replies to the following Queries must reach the Office by Monday at latest; and those selected will be published in the issue after next.

67.—What purpose is served by dermatic perspiration in the animal economy?

68.—What causes the peculiar colour of the planet Mars?

69.—How is the velocity at which light is propagated through the ether of space determined?

70.—Is there any scientific reason for the belief expressed in this saying, "A rainbow at night is the shepherd's delight, but a rainbow in the morning is the shepherd's warning?"

71.—What possibility is there of acquiring information as to the surface character of the more distant hemisphere of the moon?

72.—What is the peculiarity of Halley's comet?

Life saving has been reduced to an art by the able training of the "Life Saving Society," which teaches the best methods of resuscitating the apparently drowned, and also encourages the special teaching of swimming. A useful illustrated handbook on the subject may be obtained for one shilling, by applying to the honorary secretary, 3, Clarendon-square, N.W., who will also be pleased to receive contributions towards the worthy objects of the Society

CRANIUMS AND CRIME.

SOME REMARKABLE RESEARCHES.

Our article dealing with the craniums of criminals in the last issue of SCIENCE SIFTINGS, and the observations we recently made respecting the paper of Dr. Strahan, have aroused intense interest in the minds of many of our readers —chiefly those belonging to the medical profession—and we are asked by many to tell them something about Professor Lombroso and his work, which has caused some sensation on the Continent. The details possess special interest just now in view of the remarkable murders with which our newspapers unfortunately teem. The Austrian, Sencider, was an instance of criminal development almost without parallel, until the wretch Deeming was brought to justice. A description of the cranium of this wholesale murderer would be of great interest and importance, and we trust that Professor Lombroso will not confine his researches to Italians—although the field is so excellent—but will let his studies embrace individuals of all nationalities.

There are criminal codes, courts of law, and that surprising survival of the unfittest, trial by jury ; vast edifices, have been built as prisons and reformatories, and philanthropic persons have formed societies for the instruction of the criminal, and to care for him when his prison gates are opened. But in spite of all, the criminal becomes more numerous. He breeds criminals ; the taint is in the blood. This inexplicable fact has been the cause of the establishment of a new school, which has studied the criminal rather than the crime—which has investigated his natural history. It is known as the School of Criminal Anthropology, or the neo-criminalistic school. It may be said to have sprung into existence in 1878, when the first volume of the now famous book of its acknowledged leader, Professor Cesare Lombroso, of Turin, was published under the title of "L'uomo Delinquente," or criminal man. Cesare Lombroso is the professor of medical jurisprudence in the University of Turin. His opportunities for observing the criminal classes have been very extensive, and his collection of crania from these sources is the most important one of its kind in existence. He is regarded as the head of the school, which now numbers many distinguished adherents. The school of Lombroso insists that crime is the result of three orders or factors, namely, anthropologic, physical, and social. If social causes alone produce crime, as another school insists, why is it, he asks, that of 100 persons living under the same conditions of abject poverty only five will become thieves ? Why do the other ninety-five prefer mendicity, hunger, or suicide ? The social factor is the same for all, but the impulse to crime, born of the surroundings, becomes decisive only when the anthropologic and physical factors are found ; the organic constitution and the abnormal brain. What, then, is "criminal anthropology" ? It is the study of the being who, in consequence of physical conformation, hereditary taint, or surroundings of vice, poverty or ill-example, yields to temptation and begins a career of crime. It is to study the anatomy, the physiology, the hygiene of the criminal, his productivity, his capability of amendment, to examine into his condition and to recognise his rights. The first question which suggests itself after arriving at a solution of what constitutes crime is—are there two varieties of our race who are destitute—the one of all feeling of pity, the other of all sentiment of honesty ? It is here practically that the investigations of the new school commence. The conception of the criminal as a variety of the human species, who has degenerated physically and morally, is quite a modern one. Careful researches have been made to establish an anatomical type of the criminal, but it must be stated that some of the most eminent adherents of the new school have declared positively there is no such type. On the other hand, it is right to say that all those observers who are connected with great penal institutions agree that abnormities of the head and face of the most marked type of degeneracy prevail in greatest abundance among those guilty of the most atrocious crimes. The new school is at variance with the psychiatrysts as to the existence of moral insanity. It admits the existence of certain pathological conditions as idiocy, insanity, epilepsy, and hysteria, with which criminal propensities are sometimes joined, conditions which may be congenital or acquired ; and also exclusively moral abnormity, characterised by the perversion of absence of all moral instincts, but which is not, they contend, a disease. If there is no disturbance of the faculty of idcation, the absence of the moral qualities cannot justify the denomination of insanity. If this were permitted we should have to pronounce whole races of savage men insane. In the born criminal the mental process is in accord with the external impressions. The hope of obtaining the desired end is logical, but the process is criminal, and reveals the absence of the moral sense. The "fatalist" feature has led many to suppose that the new school would take the ground that, if crime is the result of mental and physical abnormity, the irresponsibility of the criminal, and the injustice of punishing him would inevitably follow. This apprehension is baseless ; the neo-criminalist meets the question in a decidedly practical way. Granting that the criminal has an irresistible propensity to crime, normal man, detesting bloodshed and rapine, yields to an equally irresistible propensity to shut the other up where he shall perforce be harmless. We deal with the subject under another aspect in our column devoted to "Social Science."

EFFECT OF COLD ON METAL.

The consequences of allotropic changes, which result in alteration of structure, are very great. The case of the tin regimental buttons which fell into a shapeless heap when exposed to the rigorous winter at St. Petersburg is well known. The recent remarkable discovery by Hopkinson of the changes in the density of nickel-steel (containing 22 per cent. of nickel), which are produced by cooling to —30°, affords another instance. This variety of steel, after being frozen is readily magnetisable, although it was not so before ; its density, however, is permanently reduced by no less than 2 per cent. by the exposure to cold ; and it is startling to contemplate the effect which would be produced by a visit to the arctic regions of a ship of war built in a temperate climate of ordinary steel and clad with some 3,000 tons of nickel-steel armour ; the shearing which would result from the expansion of the armour by exposure to cold would destroy the ship. Experimental compound armour plates have been made faced with 25 per cent. nickel-steel, but it remains to be seen whether a similar though lessened effect would be produced on the steel containing 5 to 7 per cent. of nickel, specially studied by Mr. Riley, the use of which is warmly advocated for defensive purposes. Further information as to the molecular condition of nickel-steel has within the last few weeks been given by Mercadier, who has shown that alloying iron with 25 per cent. of the nickel renders the metal isotropic, or equally elastic in all directions.

TO INVENTORS.—Anyone having a good Invention can, on applying to the Editor, "Science Siftings," obtain the advice and assistance of a well-known Patent Expert, free of charge.

THE PHILOSOPHY OF ELECTRICAL ACTION ON VEGETABLE GROWTH.

It is reported in a French journal that further experiments in electroculture have been carried out near Garonne, by M. Barat. The growths experimented upon were potatoes, tomatoes, and hemp. A row of hemp, subjected to the influence of the electric current, produced a row of stalks 18 inches higher than those not electrified in the same time. Two pounds of potatoes planted in the path of the current produced a fraction over 40 pounds of very large and healthy tubers, while the unelectrified patches only gave about 25 pounds of medium size. The electrified tomatoes also became ripe some eight days before the others.

A curious and important fact has been remarked by M. Barat in his experiments. If a quantity of manure is near the positive pole, the constituent parts of this manure are transported toward the negative pole, and their effects make themselves felt around a distance of some yards. This would seem to be a fresh proof of the opinion—long advanced—upon the part played by electricity in the growth of plants, an opinion also adopted by M. Specnew, who has given some attention to these phenomena ; this is, that the action of the electric current upon plants seems to consist in the more active dissolution of the organic principles existing in the soil which are thus brought within the reach of the roots. From these French experiments and others, so frequently alluded to of late in our columns, it has been demonstrated, beyond all doubt, that the application of the electric current to certain species of vegetation has the effect, in some mysterious manner, of accelerating their growth. The question therefore naturally arises, in the mind of a correspondent, by what law are such effects produced upon vegetation. Is it true, he asks, as was formerly the general belief, that electricity is a fluid substance, contained by all material things, and that this fluid is composed of, or contains, the necessary fertilising properties, sufficient to produce such effects upon the growth of vegetation ? If such is the fact, then the application of electricity to the barren lands would have the effect of clothing them with vegetation and give value to the sterile wastes upon our planet. But, owing to the advance in thought of the present century in relation to natural phenomena, the conclusion adopted by our more advanced scientists is that electricity is not a fluid substance, but that it is a force or a form of energy. If such is the case, and it does not contain within its composition those elements necessary for plant life, by what law then (would be naturally asked) does simple force or energy have the effect of stimulating the growth of vegetation ?

In order to give a satisfactory answer to this question, it is first necessary to understand, or, at least, to have some idea of the process by which plants are caused to grow. Now, the phenomenon of the growth of all forms of organic life is due to a combination of the elementary atoms contained in the soil, and it is only when such atoms are in activity that their combination and crystallisation into organic substance is possible, and that such combinations and the solidifying of the atoms is an effect of the interference of their motions. We arrive at this conclusion from an investigation of other phenomenon, as, for instance, in the phenomenon of light. It is demonstrated by experiment that an interference in the motions of the atoms which give to our minds the conception of light, have the effect to destroy the phenomenon and to produce darkness. So, also, in sound it is found that an interference in the sound waves has the effect of producing silence. For such reasons, we are justified in the conclusion that if the atoms which compose the various elements were at rest, the formation of substance would be impossible, but that it is in consequence of their continual activity, and as an effect of their interference that solid substance is produced. The reasons why such effects are the result of an interference in the motion of the elementary atoms, the peculiar process by which such effects are produced, as well as the operation of the laws which regulate their motions, is, of course, beyond man's conception ; yet we find that the law is uniform and constant in its operation, a fact of which the existence of the universe, with its endless variety of phenomenon, furnishes sufficient evidence. Under such circumstances, it is evident that any means that it would be possible to adopt, which would have the effect of accelerating the motions of the elementary atoms contained in the soil, would, from the nature of things, accelerate the growth of vegetation upon its surface, since the interference in their motions and consequently their combination, would proceed at a more rapid rate, and their crystallisation into plant life would be accelerated in a corresponding ratio. It is for such reasons that vegetation under glass, as well as steam pipes buried beneath the soil, have the effect, of putting into greater activity the elementary atoms of the soil, by a contact of atoms and to accelerate the growth of plants.

For such reasons as given, we are justified in the belief that this mysterious phenonenon known as electricity is simply the motions of atoms of some of the elements, varying, of course, according to circumstances, or of the conditions under which such motions are produced ; for instance, there are reasons for believing that the lightning flash is an effect of the intense motion of the atoms of oxygen gas which have accumulated in excess in the atmosphere above, set free from the surface of the waters of our planet by evaporation, while it is possible that the phenomenon of plant growth may be acclerated by stimulating the motion of the atoms of carbonic acid gas within the soil by imparted motions, produced in the battery by the decomposition of metallic substances ; and it may be this motion imparted by contact to the elementary atoms of the soil, by the intense motion of atoms of certain elements from without, which is termed the electric current, that explains the mystery of the increase in the growth of vegetation, as an effect of its application.

The evidences presented by the fossil remains of various forms of organic life, found beneath the earth's surface, show us that in prehistoric ages all forms of life were of a gigantic growth, compared with the present ; hence the question would naturally be asked, why are all forms of life gradually decreasing in dimensions? Is it because the elements of which they are composed are being continually lost or destroyed? No ; but since experiment has demonstrated the fact that in order to increase in dimensions the growth of vegetation it is necessary to stimulate the atoms of the elements which compose them into greater activity, it is therefore evident that the gigantic growth of organic life in the past, was owing to the greater activity of the elementary atoms. But why their motions should gradually decrease, or by the operation of what law such effects are produced, or for what special purpose, is, of course, beyond man's conception. At any rate, judging from the present growth of all forms of organic life, compared with their dimensions in the past, it is evident that the elementary atoms are tending to a passive state, for which reason we must assume that a state of rest is the normal condition of the elementary atoms of which the universe and all things are composed.

AN INTERESTING EXPERIMENT WITH STEEL.

It is agreed that the idea that steel is a chemical combination of iron and carbon is universal ; but where, asks Mr. Charles Wetterer, a New York engineer, is the proof ? When two elements combine chemically the nature of both changes —this does not happen when iron is carbonised, but a change does take place—the pulverulent carbon melts. Well, it will be said carbon has never been melted. Be pleased to hear my explanation, says the authority referred to. The atoms of carbon buried in molten iron are in a very different position, for instance, from that of electric light carbons ; it does appear that the fact that the iron is molten has a greater effect on the carbon than the temperature itself. To this action we have a parallel in ordinary illuminating gas concerning which a prominent work on chemistry says : "The light and gaseous hydrogen possesses in a great degree the power of rendering other bodies aeriform, on uniting with them, even those which are not volatile, just as an eloquent speaker can communicate his enthusiasm to an indifferent audience."

To prove this idea I have succeeded in crystallising carbon taken from steel wire nails, iron cut nails, and steel filings, by dissolving them in acids. It is, however, a difficult thing to do, the chief obstacle being that about 98 per cent. of iron must be dissolved in order to obtain about 2 per cent. of carbon. If the dissolution of the iron is violent, the gases generated carry the nascent carbon to the surface, where it is oxidised by the oxygen in the air, causing small explosions that are easily perceived in sunlight ; to this nascent state of the carbon its power to crystallise is due. If the action is less violent, or the carbon artificially obstructed, that which is so obtained resembles lampblack ; sometimes a body of the same consistency is formed, but it is white.

My first experiment was to dissolve a small quantity of steel filings in about a teaspoonful of acid, which resulted in a few small crystals, but, nevertheless, larger than the grains of steel ; by pressing these crystals into my thumb nail and drawing them across glass, they cut or scratched as only diamonds can. The result of the past six months of experimenting is small, but sufficient, I think, to establish my theory.

It may be mentioned here, in support of this argument, that diamonds on being placed in the electric arc, melt, oxidise, and disappear like a flash ; carbon in steel, on being burnt, behaves in the same manner, which would indicate not alone the separate existence of carbon, but that it is molten.

It appears to me as reasonable that when steel is heated, the atoms of carbon have a tendency to unite, and form comparatively large particles ; when slowly cooled, these particles remain large, but on being chilled the molten particles are shattered to atoms ; in this way the surface area of diamond presented to iron may easily be increased from 10 to 100 times. With this increased surface contact, and the more thorough diffusion, it is not difficult to understand why steel should harden on being chilled. It is also possible that the different conductivity of carbon and iron, and electric currents set up in the chilling metal, have their influence on the arrangement of the atoms, and possibly, on the degree of hardness or tenacity ; by drawing temper the atomic diamonds begin to gather and re-arrange slowly, until the proper degree of hardness or size and arrangement of diamond particles is shown by the colour, when further progress is arrested by quenching.

Mr. Wetterer's theories are the subject of criticism by another authority, who points out : That steel is such in consequence simply of a "combination of iron and carbon" is not or need not be "the universal idea."

Steel may be as truly steel with practically no carbon combined as though it had combined the highest percentage possible. The question : What constitutes steel, as distinguished from iron, is not to be settled simply by the presence or absence of carbon. Steel may be adjudged to be iron, because heating to hardening heat and suddenly cooling utterly fails to harden it. Iron may be called steel simply because it does harden readily under the same treatment to which hardening steel responds, and still the soft, nearly carbonless steel is just as truly steel, and the hard, highly carbonised iron is just as truly iron as though the test of hardening had shown what might be expected. It is a question of structure, not a question of carbon.

For certain uses it is necessary or desirable, to say the least, that steel should contain certain percentages of carbon, the exactly right amount naturally insuring, under proper conditions and treatment, the best results ; but that "two per cent. of carbon" exists in "steel wire nails" and "iron cut nails" must strike those who had supposed that something was known of the make-up of steel and iron in the light of a new discovery. Two per cent. ! What can be meant ? That would be too high for tool steel. More than twice as high as the average of tool steel in general use !

"When steel is heated," according to Mr. Wetterer "the atoms of carbon have a tendency to unite, and form comparatively large particles ; when slowly cooled, these particles remain large ; but on being chilled, the molten particles are shattered to atoms ; in this way the surface area of diamond presented to iron may easily be increased from ten to one hundred times. With this increased surface, contact, and the more thorough diffusion, it is not difficult to understand why steel should harden on being chilled."

Now, as a statement of facts, in our judgment, a judgment based upon much experience and observation, we say, *only* when heated sufficiently to produce such result, to the first statement ; and to the second, *only* when chilled from a right heat ; and as to the third, *i,e.*, the assumption that the phenomenon of hardening is explained by the alleged fact that chilling breaks up the larger particles, and produces a finer condition, we say, unsupported. At a right heat, there will be produced by chilling, by hardening, the promised fine condition, with hardness. At a higher heat, there will be as great hardness, but with it will come coarseness, a disorganised, uneven structure, as unlike the other as it is possible to conceive—the one as fine as flint, and as beautiful as a diamond, the other as coarse as pig iron ; both the same material, different parts of the same piece, if you please, so that to say "heating and cooling slowly or quickly produces certain results, needs to be modified. Question of, how hot ? comes into the account.

As to "arrangement of diamond particles in temper drawing as shown by colour," hardening does that arranging. Tempering, by many, is believed to change the grain, size of "particles." We question this. So again annealing softens, by many is believed to mean *necessarily* changes the grain, makes the particles coarser. This is also open to question. That it *often does*, we know ; that it is *necessary* in order to soften, is another thing. Hardening at proper heat—at the refining heat—will produce the much admired even grained condition of fineness referred to. So will working properly at proper heat ; so will cold working. No, no, we cannot settle the question of why steel hardens in this way. Let's have proof which proves.

IS MAN THE ONLY REASONER?

The "whirligig of time" may be said to be bringing to the much-neglected brutes an ample revenge. The first *naïve* view of the animal mind entertained by the savage and the child is a respectful one, and may perhaps be roughly summed up in the formula in which a little boy once set forth his estimate of equine intelligence: "All horses know some things that people don't know, and some horses know more things than a great many people." But this pristine unsophisticated view of the animal world, though its survival may be traced in mythology and religious custom, has, Mr James Sully tells us, in the *Nineteenth Century*, long since been scouted by philosophers. Thinkers, from Plato downward, have, not unnaturally perhaps, regarded the faculty of rational thought, which they themselves exhibited in the highest degree, as the distinguishing prerogative of man. The Christian religion, too, with its doctrine of immortality for man and for man alone, has confirmed the tendency to put the animal mind as far below the human as possible. And so we find Descartes setting forth the hypothesis that animals are unthinking automata. Not for ever, however, was the animal world to suffer this indignity at the hands of man. Thinkers themselves prepared the way for a *rapprochement* between the two. More particularly the English philosophers from Locke onward, together with their French followers, pursuing their modest task of tracing back our most abstract ideas to impressions of sense, may be said by a sort of levelling-down process to have favoured the idea of a mental kinship between man and brute.

Definiteness has been given to the question of the nature of animal intelligence by the new doctrine of evolution. If man is descended from some lower organic form, we ought to be able to make out not merely a physical but a psychical kinship between him and the lower creation; and the more favourable estimate of the animal mind taken by the modern *savant* is of great assistance here. Mr. Darwin has, indeed, shown in his valuable contributions to the subject, that the rude germ of all the more characteristic features of the human mind may be discovered in animals. At the same time, Mr. Darwin's investigations in this direction amounted only to a beginning. The crux of the evolutionist, the tracing of the continuity of crude, formless animal inference, up to the highest structural developments of logical or conceptual thought, still remained.

According to Professor Romanes, animal reasoning remains on the plane of recepts. It is carried on by pictorial representations. At the same time it involves a process of classification or generalising. A diving-bird must be supposed to have a generalised idea (recept) of water, a dog a generalised idea of man, and so forth. Nay, more, this receptual ideation enables the animal to reach "unperceived abstractions," as the idea of the quality of hollowness in the ground, and even "generic ideas of *principles*," as when the writer's own monkey having discovered the way to take the handle out of the hearth-brush by unscrewing it, proceeded to apply the principle of the screw to the fire-irons, bell-handle, etc.

Professor Romanes' whole account of this receptual ideation or the logic of recepts is interesting and persuasive. He has, it must be owned, clearly made out the existence of a very creditable power among animals of carrying out processes analogous to our own reasonings without any aid from language. Yet a doubt may be entertained whether the author has really got at the bottom of these mental feats. The whole account of the recept is a little unsatisfactory, owing to the circumstance that the writer does not make it quite clear in what sense it involves generalisation. He writes in some places as if the fact of the generic image having been formed out of a number of percepts corresponding to different members of a class, *e.g.*, different sheets of water seen by the diving-bird, gives it a general representative character. But this, as indeed Dr. Romanes himself appears to recognise in other places, is by no means a necessary consequence. A generic image may form itself more readily than a particular one, just because the animal is unable to note differences sufficiently to distinguish one sheet of water or one man from another. A baby's application of the common epithet "dada" to all bearded persons suggests not that it is carrying out any process of conscious generalisation, but rather that it is failing to discriminate where there are striking and interesting features of similarity. It would seem as if an idea only acquires a properly general function after certain higher intellectual processes have been carried out. These may be roughly described as the active manipulation of percepts and images, by analytical resolution of these into their constituent features, and a due relating or ordering of these elements. Only in this way does it appear possible to reach a rudimentary form of a properly *general* notion; that is to say, an idea which is consciously apprehended as representing common features among a number of distinct objects. Mere superposition of images may result in a new typical image; but the mind in which such an image forms itself cannot know this to be generic or general till these processes which underlie active thought have been carried out.

The question occurs whether an animal, say a dog, that is just coming on to understand a name or two, as that of the baby of the house, can be said to have an organised percept precisely analogous to our own percepts. Dr. Romanes does not raise the question, but, in view of the light thrown by modern psychology on the complexity of the process of perception, it might not have been redundant. But waiving this point as possibly smacking of the frivolous, we have to ask whether an animal at the stage of mental development at which it appears to begin to understand names, and even to make use of them, is capable of carrying out the processes that go along with, and in fact constitute, naming in its true and complete sense. To name an object appears to mean to apprehend that object as a complex of qualities, to make mental separation of these, and so to relate it to other objects both by way of similarity (classification) and dissimilarity (individuation). To use a name intelligently at all would seem to imply that these processes have been carried out in a rough fashion at least. This being so, we must be prepared when we endow an animal with the power of naming, whether under the form of understanding or that of using names, to say that it is carrying out in a rudimentary way at least these thought-processes. How, it may be asked, does Dr. Romanes deal with this point?

There are, according to Dr. Romanes, four stadia in the evolution of the complete logical sign or general name. Of these the first is (*a*) the *indicative* sign—that is, a significant tone or gesture intentionally expressive of a mental state, as the characteristic tones by which animals express their emotions. These are not names at all. Next to these in the order of evolution come (*b*) *denotative* signs. These, whether used by children or animals, *e.g.*, talking birds, simply mark "particular objects, qualities, and actions." They are learned by association, and are not consciously employed as names. By the use of such a sign the talking bird merely fixes a vocal mark to a particular object, quality, or action; it does not extend the sign to any of other similar

objects, qualities, or actions of the same class ; and therefore by its use of that sign does not really *connote* anything of the particular object, quality, or action which it *denotes*. Next in order (*c*) follow *connotative* signs which involve the "classificatory attribution of qualities to objects." This attribution of qualities may be effected either by a receptual or a properly conceptual mode of ideation. For example, a parrot had come to use a barking sound when a particular dog appeared on the scene. This sign was afterward extended to other dogs, showing that there was a certain recognition of the common qualities or attributes of the dog. Similarly when the writer's own child, among its first words, used the term star for all brightly shining objects. Here again there was perception of likeness, but no setting the term before its mind as an object of thought. Lastly (*d*), we have the *denominative* sign which means a connotative sign consciously bestowed as such with a full conceptual appreciation of its office and purpose as a name.

It staggers one not a little to find that long before the "classificatory attribution of qualities" is possible, the animal somehow manages to mark "particular qualities," whatever these may mean. How, one asks, can a sign be appended to a quality without becoming a "connotative sign"—that is, attributing a quality to a thing? But let us pass to the really important point, viz., the alleged power of the animal, *e.g.*, the talking bird, to extend a sign to different members of a class, and so to attribute common qualities or resemblances to these, while it is unable to form a concept in the full sense. This extension, we are told, takes place in the case of the sign-using bird by receptual ideation. And here the critic may as well confess himself fairly beaten. On the one hand, Dr. Romanes tells us that such a named recept is a concept (lower concept), and, moreover, that the sign employed is a connotative sign ; on the other hand, he hastens to assure us that it is not a name, and therefore presumably not a concept, in the rigorous or perfect sense, since the sign is not consciously employed as a sign.

Surely if a sound is used for the purpose of marking resemblances and attributing qualities, it is a genuine name, and the mental process underlying it is a germ of true conceptual thought. To say that the parrot attributes qualities, and attributes them in a "classificatory" way too, seems indeed to mean that the bird has got a considerable way along the conceptual path, and is fairly within sight of our distinctions of thing and quality, individual and class. Why logical reflection on this name as such should be needed to raise such a performance to the dignity of a true conceptual act, one is at a loss to understand.

Dr. Romanes tells us plainly, at the outset, that he is going to establish identity of kind between the animal and the human type of intellection. And, no doubt, if it were possible to do this in the way here attempted—that is to say, by interposing transitional forms which virtually efface all qualitative unlikeness—it would be a great advantage to the evolutionist. But it may be said that it is not the only way of satisfying the requirements of the evolution hypothesis. Dr. Romanes pertinently remarks, in meeting *a priori* objections to the derivation of human from animal intellection, that in the life of the human individual we actually have a series of transitions from animal to human psychosis. Now, a glance at the intellectual development of the individual shows us that distinct qualitative differences are introduced. Not to speak of the obvious fact that every new sensation effects a qualitative addition to the infant's mental life, there is the more important fact that the first image of the absent mother or nurse introduces a new sphere of mental activity. The child that dreams and imagines is already a different being from the infant that merely touches and sees. Similarly it may be said that the first conscious process of breaking up its sense-presentations, the first distinct apprehension of relations, is epoch-making, just because it marks the oncoming of a new mode of mental activity, a qualitative extension of its conscious life.

The whole subject is still a dark and perplexing one, and we must refrain from dogmatising. It may, however, be contended that the evidence, on the whole, supports the view that the generalising process is, up to a certain and not very high point, independent of language. That is to say, an animal unassisted by any system of general signs may make a start along the path of comparing its observations, resolving them into their constituents, and separating out some of these as common qualities. Whether in these nascent operations of thought there is some substitute for our mechanism of signs, we do not know, and perhaps never shall know. However this be, they remain nascent processes, never rising above a certain level. The addition of some kind of sign, which can be used as a mark of common features or qualities, seems to be indispensable to any high degree of generalisation, and to any elaborate process of reasoning. It is the want of such signs, and not the lack of the "power of abstraction," that keeps certain animals, for example, the dog, from being rational animals in as complete a sense as a large number of our own species.

THE CENTRE OF THE EARTH.

The workmen in the deepest mines of Europe swelter in almost intolerable heat, and yet they never penetrate over one $\frac{1}{7000}$ part of the distance from the surface to the centre of the earth. In the lower levels of some of the Comstock mines in America the men fought scalding water, and could labour only three or four hours at a time, until the Sutro tunnel pierced the mines and drew off some of the terrible heat, which had stood at 120°. The deepest boring ever made, that at Sperenberg, near Berlin, penetrates only 4,172 feet, about 1,000 feet deeper than the famous artesian well at St Louis., U.S.A. While borings and mines reveal to us only a few secrets relating solely to the temperature and constitution of the earth for a few thousand feet below the surface, we are able by means of volcanoes to form some notion of what is going on at a greater depth. There have been many theories about the causes of volcanoes, but it is now generally held, that, though they are produced by the intense heat of the interior of the earth, they are not directly connected with the molten mass that lies many miles below the immediate sources of volcanic energy. Everybody knows that many rocks are formed on the floor of the ocean, and it has been found that a twentieth to a seventieth of their weight is made up of imprisoned water. Now, these rocks are buried in time under overlaying strata, which serve as a blanket to keep the enormous heat of the interior. This heat turns the water into superheated steam, which melts the hardest rock, and when the steam finds a fissure in the strata above it, it breaks through to the surface with terrific energy, and we have a volcano. We find that these outpourings that have lain for countless ages many thousands of feet below the surface are well adapted to serve the purposes of man. Many a vineyard flourishes on the volcanic ashes from Vesuvius, and volcanic mud has clothed the hills of New Zealand with fine forests and its plains with luxuriant verdure. The most wonderful display of the results of volcanic energy is seen in the north-western corner of our own land, a region of lofty forests and of great fertility.

CURIOUS CREATURES.

According to Mr. Langley, the Secretary of the Smithsonian Institution, the light emitted by the Cuban fire-fly is the "cheapest" in the world—produced, that is to say, with the least heat and the smallest expenditure of energy—and he believes that a successful imitation of it would prove a most profitable substitute for gas and electricity. The insects are beetles, 2 inches long, and belong to the family of "snapping insects," so called because, when one of them is laid on its back, it snaps itself into the air with a clicking sound.

The secret of the light this fire-fly gives, is as yet undiscovered. Apparently it is connected in some way with the mysterious phenomena of life, and chemists and physicists have sought in vain to explain its origin. On each side of the animal's thorax is a luminous membranous spot, and these flash at intervals so that the Cubans put a dozen of the insects in a cage together and so obtain a continuous illumination bright enough to read by. This light is accompanied by no perceptible heat, and is seemingly produced with almost no expenditure of energy. How great an improvement it represents upon all known artificial lights can be imagined when it is stated that in candle-light, lamp-light or gas-light the waste is more than 99 per cent. In other words, if they could be so obtained as not to throw anything away, they would give nearly 100 times the illumination which they do afford. Even the electric light is mostly waste.

The "Hercules beetle" comes from Africa and is exactly 6 inches in length. The head and horns alone measure 4 inches, and resemble a huge black crab's claw. Though seemingly a pair of very formidable nippers, with sharp teeth for biting, these horns are in reality merely for ornament. They are made of chitin, one of the most enduring substances in the world, which in many fossilised insects is found to have outlasted the ages. A smaller cousin of this creature, known as the "Rhinoceros beetle," is about 2 inches long, and is plentifully found in many parts of the United States. It is chiefly celebrated for its offensive smell, which has at times rendered some towns almost uninhabitable, necessitating action by the health authorities. The animal lives in decaying logs and stumps, feeding upon rotting wood.

There are many kinds of beetles in the United States, which are as good for the purpose of blistering as the Spanish fly, belonging to the same family with it. One species in and about Washington preys destructively upon the petals of chrysanthemums and asters, but has the redeeming habit of devouring grasshopper's eggs. In Southern Europe the cantharides insects are gathered by shaking them at night upon sheets from trees on which they have gone to roost in flocks. Then they are exposed in sieves to the vapour of boiling vinegar, after which they are dried in the sun, and are ready for sale in the drug shops. The flesh of all "blister beetles" contains a peculiar chemical compound, called "cantharidin," which burns the skin.

There are many mysterious things about beetles. Those of Brazil are famed for their brilliant metallic hues, yet no one has been able to find out what makes these colours. Some are of gold, others of silver, yet others of blue enamel seemingly, and so on, through an endless variety of tints. One variety is called the "diamond beetle," because it is covered with minute points which reflect the light. Their use for jewellery is familiar. They are employed for trimming dresses, and sometimes a particularly fine one is kept alive and allowed to wander over the corsage of the wearer, attached by a slender chain.

The sacred scarab, or beetle, of Egypt, was the "tumble-insect," which forms bits of manure into a ball for laying its eggs in. Two individuals, male and female, always roll the ball together, and they do this merely for the purpose of conveying it to a safe place and hiding it. This insect was regarded as a symbol of the Creator among the Hindoos, from whom the idea passed into Egypt. The ball was imagined to represent the world, because it was round, and was supposed to be rolled from sunrise to sunset. Even at this day Egyptian women who desire children eat the beetles for that end.

There are many gigantic insects, of which no specimens are seen in this latitude. In the tropics such creatures grow much bigger, and there is hardly a group of them known to the naturalist which does not have giant representatives in the torrid zone. Doubtless the warmth of those regions, which produces luxuriance in vegetable life, has similarly favourable effects upon certain branches of the animal kingdom. At all events, snakes in general and various species of bugs in particular, seem to profit by it.

In the tropics are found many kinds of great hairy-spiders, some of which have a spread of legs that will cover a tea-plate. One of these unpleasant creatures will sometimes weigh as much as half a pound. They are called "tarantulas," although the real tarantula is an insect only found in Southern Europe, where so many superstitions respecting it prevail. Most of the big spiders of the New World are of the sort which build nests with trap-doors lining a hole dug in the ground, with silk, fitting it with a door so artfully made as to hinge, bevelled edge and spring that it is almost impossible to detect the fact that there is an opening, and, in some cases, actually planting seeds on this dainty portal for the purpose of concealing it with growing plants. Some of the largest spiders catch birds, and individuals have been known to capture good-sized fishes, lying in wait for them at the border of a stream.

In South America there are giant grass-hoppers with bodies 5 inches long and a wing-spread of 10 inches. Owing to the fact that they are not very numerous, these formidable insects do not do much damage. Nearly everyone has seen the curious "walking-sticks," so-called, which resemble twigs so closely that it is difficult to realise that they are living animals. Members of this family in the tropics grow to a length of 11 inches. There are tropical cockroaches 4 inches long, with antennæ to correspond, which readily become domesticated in houses. A tropical moth, called the "Atlas" moth, has a wing-spread of 1 foot. It is grey in colour and flies by night. There are most beautiful butterflies in the Malay Archipelago, of an exquisite blue and other iridescent hues, which measure 8 inches from wing-tip to wing-tip. In South America there is a beetle even bigger than the Hercules beetle. It is over a foot long, legs and all, though its body is not so heavy.

THE statistics of life insurance show that in the last twenty-five years the average of man's life has increased 5 per cent. or two whole years, from 41·9 to 43·9 years. Woman's life average has improved even more than this, from 41·9 to 45·8 years, or more than 8 per cent. Out of every 1,000 males born at the present day twenty-four more will attain the age at 35 than used to be the case prior to 1870; the combined life of every 1,000 persons born at the present day is 2,700 years longer than it was twenty-five years ago. The average human life is now being added to at the rate of nearly ten years each century.

SOCIAL SCIENCE.

A NEW CRIMINALITY.

The recent growth of crime in Europe is so startling that it cannot be overlooked. The first conclusion is that the accomplice of two-thirds of the crimes committed, upon whom the criminals themselves throw the responsibility of their evil deeds, and whom the police never succeed in discovering, is alcohol. This is not a startling suggestion, for we have heard it before. The only trouble is that we are likely to become familiar with such facts and lose the force which they should bear on our actions. But in this case we are not allowed to rest with general facts. We are hurried to an array of facts that are not only novel and startling, but in our conception the most terrible of anything ever revealed by criminal statistics. Here let us state the conclusion before quoting facts. Alcohol visits upon the child the sins of the father, and engenders in the following generation homicidal instincts. During the last ten years the criminal type has entered on a new phase. Before that date the assassin was generally a man in the vigour of his strength and manhood; nowadays it is the youth who murders. The jurymen hesitate to condemn him on account of his age, although they are horrified at his cold-blooded ferocity and at the absence of moral sense which he displays. The writer of a recent report on crime says, that he has in the haunts of vice and misery in Paris, observed gutter-children by the thousand who are only waiting opportunity to become assassins. Using the old division of the human mind into intellect, emotion and will, he discusses the effect of alcohol on these subdivisions of brain activity. So far as will is concerned he allows that this peculiar class of depravity is well endowed. The question is, what kind of will is manifested, and whether there is an honest balance of the emotions to direct the use of will force. So far, then, as mere brute courage is concerned, there is no lack of this growing element in the substratum of society. Their temperaments are alcoholic; that is, bold and violent; their action corresponds. It must be added that, as a rule, the hereditary alcoholist is very intelligent also—wilful and intelligent. There is no lack of shrewdness in his plans or of fact in self-defence. The real seat of the difficulty with these young born-criminals is the emotions. It seems at a glance impossible that a thoroughly intelligent and courageous person shall be innately evil to the extent of being a devotee of murder. There are words to express defect of will, others denote mental aberration, but none to note the absence of affectionate emotions. But a word of this sort is needed to describe the pitilessness and insensibility of this new class of criminals. Most of us are conscious of a measure of altruism, a feeling that takes us out of ourselves and makes us rejoice in the joy of others. We call this love either for family or friends or children, for the poor or the griefstricken, for humanity or for God. Education can cultivate but cannot create this sentiment of the soul—this abhorrence of wrong and suffering, and desire to promote the right and happiness. Now, can we conceive this element left out, or even reversed? Can we comprehend that influences may dominate at conception and birth, in all the most plastic period of life, that shall reverse the love spirit, and leave it a malicious spirit? We think we may conceive this as possible in rare cases. The French Revolution brought to the front a few men like Marat and Robespierre and Mirabeau, who had the birthmark of hate. Similar circumstances would no doubt bring out a similar percentage of malign leaders—revellers in blood. So few of these, however, would there be, that we could not be sure that extraordinary circumstances had not turned their brains. But it is certainly very difficult to imagine that a very general and fatally criminal use of alcohol is creating a very large and fearfully growing class of emotional maniacs—sound in will and intellect, but as cruel in nature as a drunkard when intoxicated. Yet we are told, and the proof is made most abundant, that the use of absinthe, and brandies, and all liquors that make parents ugly and dangerous is stamping the ugly and dangerous on their children. Why should this not be so? Yet we have not been prepared to see such an extreme result of heredity as the creation of a race of thugs in every centre of civilisation.

Our authority selects a case which, he assures us, may be multiplied in courts of justice whenever pains are taken to define such cases. "It was in the House of Correction that the strangest and most atrocious crimes were related to me, with hardly dissembled childish laughter." He says: "A few months ago I was present in Dr. Garnier's consulting room, watching the prisoners from the depot filing past. We were informed that a child had been brought in by its parents to be examined. These people belonged to the respectable working class, and were both quiet and well-mannered. The man was driver of a dray, belonging to one of the railway stations, and had all the appearance of a stalwart working man. The boy was barely 6 years old; he had an intelligent, rather pretty face, and was neatly dressed. 'See here, Monsieur le Docteur,' said the father, 'we have brought you our boy. He alarms us. He is no fool; he begins to read. They are satisfied with him at school; but we cannot help thinking he is insane, for he wants to murder his little brother, a child of 2 years old. The other day he nearly succeeded in doing so. I arrived just in time to snatch my razor from his hand.' The boy stood listening, with indifference and without hanging his head. The doctor drew the child kindly toward him and inquired: 'Is it true that you wish to hurt your little brother?' With perfect composure the little one replied: 'I will kill him—yes, yes, I will kill him.' The doctor glanced at the father and asked in a low voice: 'Do you drink?' The wife indignantly exclaimed: 'He, sir! Why he never enters a public house; and has never come home drunk.' Nevertheless, the doctor said, 'Stretch out your arm.' The man obeyed; his hand trembled." The story goes on to show that these people really intended to tell the truth; but the man was a deliverer of packages, and all day, at private houses, he was offered a drink for his trouble. He had become a drunkard without knowing it, and the poison that had entered his blood was at that moment filling the head of his little child with the dreams of an assassin. Is society now really breeding a class such as is here described? Are the instances quoted sporadic and accidental? This is a terrible question, but we believe it must be answered in the affirmative. In our own country there have not only been some astounding cases of youthful love for assassination and pain-giving, but we know that the average age of criminals is considerably lowered. Part of this may be due to the increased precocity of the young in all ways, more especially to the crowding of their intellectual development in school life without the least consideration whatever of their emotional natures. And when we come to a full understanding of the case we shall probably see that behind intemperance itself lies the mischief of a one-sided school training. The family gives over the child to public culture, and the public school considers its duty done when it has sharpened the boy's wits. There is no question but that emotionally our young people are less poised than formerly in the days of more home training.

These cases of precocious criminality, our authority assures us, are easily multiplied from his own experience. But more

authoritative is the opinion of the eminent Dr. Paul Garnier who is Chief Medical Examiner of the Prefecture of Police in Paris. His figures prove that during the last eighteen years lunacy has increased in that city 30 per cent. "This increase is due to the fact that two morbid types, general paralysis and alcoholic insanity, are spreading to an alarming extent. Alcoholic insanity is now twice as prevalent as it was fifteen years ago."

"Alcoholic insanity" is a new term; but let us understand that it means in this case simply transferring the conditions of drunkenness from the father and mother to the child. Inebriation makes a man, during the continuance, crazy; as a rule it renders him emotionally insane; he is probably ugly, and possibly homicidal. The deaths caused by the brutality of drunken people are enormously beyond all published statistics. Directly and indirectly wives, babes, unborn babes, are unsafe in the presence of this monstrous condition. Half of these deaths are concealed, or not quite definable. Alcohol is in the propagating generation enormously homicidal. Why shall it not be transferred, and become a characteristic of the children of drunkards? It seems impossible to escape this consequence. The danger is not in making these children imbeciles, but emotionally unaccountable; in giving over to them the excitable, inhuman, crazed sentiment, and fixing upon them a permanent intoxication of the moral nature. The more fiery and poisonous alcoholic drinks now in use increase the tendency and the evil. It will, of course, be asked: Why has not this state of things followed drunkenness in past generations? Undoubtedly it has, but it is now intensified. Dr. Garnier notes for us an enormous increase of an existing dangerous class, due to increased consumption of alcohol, and to a decrease of counteracting influences. We believe the greatest crime a human being can commit is to curse his own posterity; but greatest of all is the enormity of indulging habits that rob our children of sanity.

The cure for the evil must, of course, be sought for. It will do but little good to appeal to those who love intoxicants. Already enfeebled in their sentiments of honour and unselfishness, little can be directly hoped for from them. Already their moral sentiments are homicidal. It matters little also, to the vendor of intoxicants whether these things be true or not. The man who can see the ruin caused in the parents by strong drink can easily endure unflinchingly the facts to which we call attention. He, too, is homicidal. It is his profit in part, but still more his moral gratification in brutal passions, that controls him. He is virtually insane in his emotions. It sometimes, however, seems possible to make a plea that will reach that other class and that will effectively persuade them—we mean those who gave the drinks to the father of the little assassin. Going from house to house he was everywhere "treated" with a glass, until he had unconsciously so far become a drunkard that his nervous system was shattered and his children's moral sanity endangered. It sometimes seems possible to shape an appeal to those who, in many diverse ways, co-operate with drunkenness, and who, at least, do nothing to discountenance the drink habit. This natural supposition we have largely given up. There are other insanities besides that of alcohol, and among them are those of vanity and liberty, a lack of willingness to consider the dangers of society and to sacrifice popularity for virtue. Heroism is not a predominant trait in society. Our only leverage is through education. The emotional nature is after all the director. Not one person in fifty is guided by reason, but by feeling. What men instinctively desire, that in the main they do; and that they will do to the end of time. We must educate the emotions, the desires; and when these have by birth an evil bias, we must educate the victim to use the reasoning faculties with austere determination to control them. We know men in high families whose emotional natures are to-day constantly held in the channel of right only by their intellectual perception of the consequences of not doing this. But what can we do with an accumulating lower element of society, whose instincts are homicidal, bloody, diabolic—precisely when sober what a drunkard's are when drunk? We must educate and create a people that has a clear comprehension of the effects of intoxicating the emotions. What shall we do about it? can only be answered by, We must create moral natures, moral drift, moral instinct.

SAVING HUMAN WEAR AND TEAR.

Dr. Colin, regimental physician in the French army, has published the results of his investigations into the effects of regular marching in disciplined bodies upon soldiers. The regularity of the step causes the indefinite repetition of a shock of the bones and brain, infinitely more deleterious than an irregular walk, and to this regular repetition of the shock to the same parts of the body is due the peculiar aches, pains, and illnesses of the troops. In a one-day march, he says, this shock is repeated 40,000 times, and often the strongest men, who can walk the same distance without difficulty when not in line, succumb to the strain in two or three days. Dr. Colin's preventative is a rubber heel in all military boots. This heel has been tried at his instance in the French infantry, he says, and the result has been found to be a great relief to the soldiers.

HELPFUL HINTS:

Being Answers to Correspondents.

Questions to which answers are desired in this column must NOT *be marked "Science Queries and Answers."*

J. E. Ling.—In reply to your question as to the nature of a vacuum, absolute vacuity is a thing inconceivable, so far as we know, as existent within the limits of the stellar universe. All space in which light is known to travel must be filled by ether, or, failing that, by matter; and pure extension may, therefore, be considered as an abstract property of space.

E. Kennedy.—Thanks for the questions sent with your letter, which is personally interesting to us. We do not doubt that your suggestion as to the genesis of comets is as original with you as the other speculations, which you have so ingeniously formulated. It must be remarked, however, that a theory tracing the origin of these singular objects to eruptions from the sun was published many years ago.

An Enquirer.—The paper you quote possesses no reputation for accuracy, and we could scarcely see our way to spend time in refuting its statements. Your speculations in regard to "angels" are unsuited for publication in our columns.

Anonymous.—We cannot, as a rule, notice anonymous communications. However, your question as to how the moon—a smaller body than the earth—can emit, by reflection, a light of intensity equal to $\frac{1}{800000}$ of that of the sun, appears to be a generally interesting one, and, for the benefit of those readers who are beginners in the study of astronomy, we will endeavour to reply to it clearly. The earth receives about $\frac{1}{2400000000}$ of the sun's radiation, and the effective surface of the moon, as a reflector of solar light, is about $\frac{1}{13}$ of that of the earth. Multiplying the denominator of the first-named fraction by 13, we obtain, with sufficient accuracy for present purposes, the amount of solar radiation intercepted by the moon as $\frac{1}{31200000000}$ of the whole. Your question is, then, since it is only this very small proportion of the sun's light that can be returned by our satellite, on the supposition that her surface is a perfectly reflective one, how can it be correct to state, as has been stated in Science Siftings, that the moon possesses $\frac{1}{800000}$ of the luminosity of the sun? It is essential that you should recognise the identity of the law of inverse squares as applied to the intensity of light, and as applied to the surface of a sphere. You will then perceive that whereas the inverse square of the distance is a factor in the preceding statement of the moon's comparative luminosity, it is not a factor in the statement of the sun's luminosity, with which, inferentially, the comparison is made. Now the sun is at a distance

from us about 388 times that of the moon. The square of 388 is 150,544. Hence, were the luminosities of the two bodies equal, we should receive, roughly speaking, 150,544 times less light from the sun than from the moon. Dividing the above-named fraction by 150,544 we obtain, for the corrected earth-lighting power of the moon, $\frac{1}{207248}$ of that of the sun. This is on the assumption that the surface of the moon is perfectly reflective. Of course it is not so, and in consequence the smaller fraction published in SCIENCE SIFTINGS is a much more accurate expression of the facts. As the angular dimensions of the sun and moon are equal, from our point of view, it is also approximately correct to say that the luminosities of unit area of the two radiants bear to one another the proportions indicated.

INCREDULOUS.—In order that the gentleman, of whose beliefs you write to us, should be convinced by a rational process of their untenability, it would be necessary to conduct him, with more or less particularity, through several distinct and extended branches of scientific inquiry. This cannot be done within the limits of our "Helpful Hints"; but we propose, in course of time, to publish a series of educational articles that will tend, no doubt, to strengthen public confidence in the applicability of physical science to cosmology.

H. E. BOTTING.—We thank you for the correction. See "Gleanings of the Globe," p. 340, also p. 366.

For "SALE AND EXCHANGE" Column see Page 384.

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SCIENCE NEWS AND NOTES.

"How much better to be the stream that keeps itself pure by carelessly dashing and boiling against the rocks than the green, slimy pool, never ruffled by a breeze, but stagnating calmly and hopelessly into mud."

—BEN. DISRAELI.

Capital Punishment

has recently been under consideration by the Medical Society of New York. The report has just been published, and it appears to have dealt with the question rather from the medical side than the metaphysical, and the conclusion it comes to is that the society "having the advantage of physiological knowledge, and being aware of the difficulties of being always correct, and of the absolute impossibility of making a positively safe diagnosis in every case of alleged crime or presumable cerebral disease or anomaly, expresses its opposition to the perpetuation of capital punishment, and its hope that means will be found to protect the community by less uncertain and less inhumane methods."

Capital Punishment Should Certainly be Abolished

if the means to supplant it suggested in the report could be found. The impulses that have prompted this opinion are certainly humane and scientific, but we fear the difficulties are insurmountable. The society, as we have already pointed out, did not deem it expedient to deal with the nature of crime, of responsibility or irresponsibility, of the cerebral functions called judgment and will, the existence or non-existence of a free will and its limitations, from any other than an anatomical and physiological point of view—that is, a strictly scientific point of view. Therefore, they confined themselves to the consideration of a subject in which trained thinkers on questions medical would feel the deepest interest, and in which they, as trained thinkers would be most useful in advising. From this standpoint they come to the conclusion that "Crime is an evil impulse that ought to be controlled." The controlling powers are the cerebral functions, of judgment and will. They add the physical argument. "Whoever is held responsible for his aberrations and his wrong-doings is termed and punished as a criminal." But "whoever is considered irresponsible is no longer a criminal to be punished, but a lunatic against whose vagaries society takes pains to protect itself." So amongst civilised peoples both the punishment of the criminal and the incarceration of the hopelessly insane are, or ought to be, but different modes of self-preservation. By truly civilised men they say "the theory of revenge or retaliation has been given up long ago. Their minds are more bent upon the preservation of the physical and moral health of the community than on the spiteful annihilation of the rebel against the common welfare."

The Boundary between Responsibility and Irresponsibility

is extremely uncertain, and forms a puzzling factor to a satisfactory solution of the capital punishment question. Many of the physical changes which lead, or can lead, to criminality may be preventable, and may be due to no fault of the criminal in so far as their first starting forth is concerned. The servant girl who lets a baby fall may maim it for life, or may so affect its brain as to change the current of its thoughts and feelings into criminality. Infants that are born with certain diseases, and their physical or moral consequences, owe their development into healthy or sickly men, to the skill of the medical practitioner. The influence of disease and conditions of the heart and circulation on the brain and the cerebral functions; the diffuse affections of the brain from various physical causes; and, above all, that inanition of brain which springs from overwork and anxiety, are adduced as common causes of aberrations with which medical men are conversant from their daily observations of mankind, and which account for very much of what the ordinary and even the judicial mind designates as crime and visits with punishment, sometimes, it would seem, on the principle of retaliation. The symptoms of most of these conditions may resemble each other very much. The society mentions one instance of this in the case of a negro who is, at this moment, on his trial for murder. He is known to have severe attacks of epilepsy. Experts have sworn he is a criminal. Experts have sworn he is diseased and not responsible. What does it teach? It teaches that there is surely reason for a doubt as to the causation of the criminal act. It should also teach that society, as represented by the jury, and as represented by the humane spirit of the times, ought to keep a sharp look-out on its own dignity. A man may blunder, but society cannot afford to be brutally mistaken where it is at the same time accuser, judge, jury, and executioner.

Tobacco as a Cause of Depopulation

in France is advanced by M. E. Decroix, a well-known anti-tobacconist. The arguments by which he seeks to fortify this opinion are by no means void of ingenuity, and are supported by the evidence of investigations and information contributed by various medical men, and of the vital statistics afforded by different departments of the country.

Among the former there seems to be a consensus of opinion that tobacco consumed in excess exhibits, in various degrees, a constant sedative influence upon the reproductive system. A series of experiments by Dr. Depierras are quoted in order to show that the same rule holds good among the lower animals. In this case the offspring of cocks and male rabbits, exposed to the fumes of tobacco, are said to have proved feebler and shorter-lived than those born under natural conditions. The conclusions founded upon statistical testimony are very emphatic, more so, indeed, than we should consider to be justified by the accuracy of the method pursued in this inquiry. After comparing ten departments in which a greater, with ten others in which a less, amount of tobacco is consumed, M. Decroix, by summing up their collective disparities, has no difficulty in showing that in the former there is a marked excess of deaths, of stillbirths, of divorces, of illegitimacy, which he takes to be a mark of morbid vitality, and a falling-off in the size of families. When, however, we compare the departments with each other separately, we frequently miss that evident connection between cause and effect, which the author's views on tobacco would lead us to expect, and as the *Lancet* points out. it is clear that we must, in many cases, allow for the action of other influences in producing the result for which it is blamed. Under the circumstances, we cannot agree with all the propositions advanced in this paper. At the same time, it cannot be denied that the excessive use of "the fragrant weed" is to be numbered among the forces opposed to a continuance of healthy life.

The Perpendicularity of a Monument

is, although few may be aware of it, visibly affected by the rays of the sun. On every sunny day a tall monument has a regular swing leaning away from the sun. This phenomenon is due to the greater expansion of the side on which the rays of the sun fall. A pendulum placed inside, say, Nelson's column, in Trafalgar-square, would be found to describe on every clear day an ellipse of nearly half an inch in diameter.

The Compass Plant

grows in the prairies of Western North America, and, as its name indicates, is of great value to the wanderer. It is a dwarf variety of the osier, is perennial, attains usually a height of 3 feet 6 inches, and has a head of yellow flowers. The help it renders the traveller arises from the fact that the long leaves at the base of the stem, which are placed, not flat as in plants generally, but in a vertical position, present their edges north and south. The peculiar propensity of the foliage of this plant, is attributed to the fact that both surfaces of its leaves display an equal receptivity for light. All the other known varieties of its class are characterised by the presence on the lower surface of their leaves of from twice to thrice as many respiratory vessels, as are contained on the upper surface, which is therefore the more sensitive of the two to the influence of light, But both surfaces of the compass plant are clothed alike, with an epidermis exceptionally receptive of light; and the same instinct of its leaves that prompts them to require an equal distribution of light upon either surfaces causes them to assume a vertical position, and to point their edges due north and south. Travellers on dark nights are said to feel the edges of the leaves, to ascertain the points of the compass, when no other means are available for helping them on their way.

The Action of Acids upon Aluminium

has been causing much alarm in the public mind since a soldier belonging to a German cavalry regiment was taken seriously ill after drinking some cognac from an aluminium bottle. It appears, however, quite possible that, in this instance, the evidently strong action of the cognac on the metal was caused by the presence of iron, as it is well known that, although the pure metal is frequently unacted upon, yet when it is in contact with another metal, galvanic action is oftentimes set up, and consequently corrosion of the metal takes place. We have an instance of this in the case of the aluminium alloys used in telescopes and binoculars intended for marine purposes. They are frequently found to corrode after being at sea for a very short period. The matter has been the subject of much investigation. After numerous experiments, Messrs. Lübbert and Roscher came to the conclusion that the metal should not be used for any purpose in which it may come into contact with liquids intended to pass into the human body.

This Dictum is Upset

by Prof. Lunge, who was dissatisfied with the methods pursued by these investigators. The conclusions he came to were as follows :—The action of coffee, tea, and beer is *nil* or practically so ; *that of brandy is also extremely slight :* the action of acids and acid liquids (wine, sour milk, fruit, juices) is more pronounced, but even in this case, he says, far too slight to cause any alarm whatever. Taking the worst case, that of acetic acid, he found a maximum attack of less than five milligrammes per 100 square centimetres in six days, and a canteen holding a litre, and having an inner surface of about 600 square centimetres and an aluminium weight of about 200 grammes, would, he says, in the very worst case lose five milligrammes in a day, or one gramme in 200 days, even if it were always full. This, he holds, is certainly too trifling an action to be considered; there is not the slightest danger of any injurious action upon the human body by such traces of aluminium compounds, and they are not poisonous, he affirms, in the ordinary sense as compared with compounds of arsenic, mercury, lead, and copper, and before they can act injuriously, quantities a hundred times larger than those he found to be regularly entering into the human stomach would have to be ingested. Finally, he adds, aluminium may without any fear be employed for canteens or any other vessels used to hold articles of food, at least at ordinary temperatures. We should certainly like a decisive opinion respecting the advisability of using this extremely beautiful metal for the purposes set forth. We may mention that Mr. Brin, the well-known scientist and inventor, has informed us in the course of conversation, that he is firmly convinced as a result of his own experiments, that aluminium is not oxydisable. This is important evidence coming from such a source.

Silver Thaw

is a most curious meteorological phenomenon that has lately been studied with much care at the Ben Nevis Observatory. By silver thaw is meant rain falling when the air is below freezing point and congealing as it falls. The phenomenon points to an inversion of temperature at the time, the temperature on the hill top being considerably lower than at higher altitudes. It was observed that most cases occur just before a thaw, and that the wind rarely attains the strength of a gale during silver thaw. On the other hand calms were rare during the phenomenon. The clouds form, and it has been found that the occurrence of silver thaw has some relation to the prevalence of storms.

Bathing in Molten Lead

has frequently been attempted as far as the hand is concerned, but, of course, only after it has been prepared. Such a bath has, however, been taken without any preparation by John Adams, of Tacoma, Washington, and he is still alive and comfortable. He fell into an immense pot of molten metal at the smelting works where he is employed, sank to his arm pits, grasped the rim of the pot with his hands, and with one mighty effort drew himself out and plunged into an adjoining vessel filled with cold water. Thanks to his heavy outer clothing and woollen underwear. the metal had not time to act upon his skin, and only his hands were seriously burned. But if the whole transaction had not occurred in one-fourth the time the reader has devoted this paragraph, there would have been a different story to tell.

The First White Butterfly

has made its appearance and been captured by Mr. T. Parker, a reader of SCIENCE SIFTINGS, who sends the details of his capture and his views about the early appearance of this harbinger of warmer weather. He does not, however, consider his capture a sign of the forwardness of the season, for it occurred over a month ago, when the thermometer was at freezing point, and the situation was neither "field-path, green, nor lane," but in his own parlour, where he observed this undue specimen of *peris rapae* clinging to the ceilng. It was the more remarkable as this is not a hibernating species like the tortoiseshell, red admiral, and peacock butterflies. He supposes the larva must have come in with some cabbages (its food plant) last autumn, and, having crawled to some corner, changed to a chrysalis, and that the warmth of the room brought out the butterfly before its time.

The World is Still Waiting

for Mr. Edison's long promised electric motor to be operated directly by heat, without the intervention of steam. When that is accomplished, steam will be relegated to the past. That such a result will be reached, by Mr. Edison or some other inventor, can scarcely be a matter of doubt. Until then, we must be content with electricity as a secondary power, a simple carrier of energy. Even in such a capacity, it is working wonders in a hundred different directions. We have already in sight an electric motor which will prove an important advance—one which will do away with the noise and dirt of the steam locomotive on the rail; which will enable us to double the present rate of railroad speed and which will put aside the horse, the trolley, the cable, and storage battery. All this Mr. Edison promises to exhibit at the Columbian Exhibition. He has thus far proven a man of his word. Let us hope he will not disappoint us in this his latest promise.

Telegraphing by Induction

was referred to in an early issue of SCIENCE SIFTINGS in connection with some experiments by Mr. Edison, in which the principle was applied to the establishment of communication between ships at sea or from a ship to near-by land—say from five to fifteen miles—and, of course, without connecting wires. On board a ship a metallic condensing surface would be placed near the head of a mast, from which a wire would extend to another condensing plate secured to some part of the hull. A similar apparatus would be placed on the adjoining land or upon a near-by ship. Communication between the two is established by induction, and messages sent and received by proper receiving and transmitting devices connected with either of the condensing apparatus upon the two ships or upon the land. This device has been patented by Edison, and is quite similar in principle to another upon which Mr. Nikola Tesla is experimenting.

Tesla's Experiments

will completely revolutionise marine warfare. It is suggested that by the use of a dynamo of sufficient capacity, an inductive current might be sent from the shore to a war vessel within attacking range, which would paralyse her crew, the induction being taken up by the armour plates of the attacking ship. Waves of induction are quite different in character from a direct current. They will pass through air, water, and even solid matter, as a brick or stone wall, as readily as light through glass. Such a principle, if made thoroughly practical, would have a high value in the arts of peace as well as war. Such a current would penetrate a fog, for instance—which the most intense arc light will not to any great extent—and might be taken by the receiving apparatus of either a wooden or iron ship as it approached a dangerous coast. By the same means, as above alluded to, devices might be invented by which messages might be conveyed back and forth. These induction waves may also be sent through earth as well as water without connecting wires.

Edison's Solar Telephone

was some time since referred to in our columns. It is a device by which Mr. Edison hopes to be able to receive, through a peculiarly constructed telephone, sounds from the sun, when that luminary shall be in one of its periodical spasms of commotion, as it now is, as revealed to the eye by the unusual size and number of spots on its disc. Mr. Edison, it will be recollected, had placed a large number of poles around a small mountain of iron ore, and arranged upon them a circuit of the most perfect and sensitive copper wire. The mountain was to be his magnet, while the wires were to conduct the sound through a proper receiver to the ear. Unfortunately for the experiment, a violent hurricane swept over that part of the country, simultaneously with the present indications of disturbances on the sun, and threw down the poles and wires. The ground is covered with snow and frozen so hard that it is impossible to re-erect the poles at the present time, consequently Mr. Edison has been deprived of the means of putting his plans into execution during the present most favourable opportunity; but he is not discouraged. He will re-erect his poles as soon as practicable, and secure them so firmly that no ordinary blizzard can overthrow them. He continues to express the most perfect confidence in the idea. He believes that the disturbances will reach the earth on waves of electricity a little more than eight minutes after they have occurred, having travelled with the speed of light at the rate of about 190,000 miles a second. They will be changed into sound when they reach the copper wire, and may then be received by the ear or transferred to wax for subsequent use.

Fortunes Made in Electricity

are still to be made, and they are worth having if they are to be gauged by those already made. The leading electricians of America appear to have been the most fortunate. Most of them, it is said, were telegraph operators and began their careers in poverty; but Professor Bell, of telephone fame, is now credited with the possession of upwards of £2,000,000. Mr. Edison is not far behind him, and Charles F. Brush and Elihu Thomson are near enough for easy sociability. Frank J. Sprague, Franklin L. Pope, and many others, are also estimated well up in the hundred thousands. The American Institute of Electrical Engineers is said to include more millionares in its membership than any other scientific body in America.

GLEANINGS OF THE GLOBE.

THE moon moves 3,333 feet per second.

A GOLD coin depreciates 5 per cent. of value in 16 years of constant use.

FOUR pounds of gold were recently collected from the soot of the chimney of the Royal Mint in Berlin.

DIAMONDS and crystals can be distinguished from glass and paste by touching them with the tongue. The diamonds feel much colder.

CARBON is so good a conductor of electricity that in the form of coke it is used to make an earth connection for lightning rods.

THE Marquis of Salisbury is an enthusiastic scientist, and possesses one of the best appointed laboratories in the Kingdom. He is also a reader of SCIENCE SIFTINGS.

THE redevelopment of lost limbs is declared by an English naturalist to be not unusual among insects, in whom it may take place either during the larval or pupal stage.

A NEW scientific paper, to be called *The Philosopher*, will appear this week in New York, under the auspices of Victoria Woodhull (Mrs J. Biddulph Martin).

A BORING at Brohl, on the Rhine, has been worked for carbonic acid for fifty years, but its supply is now failing on account of the opening of eight other borings which are now in operation near it.

KANSAS City is now experimenting with a system by which cold air is to be conveyed by pipes into business houses and dwellings, and ice made in refrigerators at one-third its present cost.

THE use of oil as fuel seems to be slowly but surely gaining favour. Trials have recently been made in some of the largest power plants in America, which have shown both economy and efficiency in the new fuel.

A SPECIMEN of capped petrel, a bird supposed to be an extinct, or at least a lost species, was found recently in England. The original home of the petrel is said to have been the islands of St. Domingo and Guadaloupe.

THERE are doubtless scores and hundreds of bodies that are larger than the sun among the so-called fixed stars visible to the naked eye. Certainly Capella, Arcturus, Sirius, Vega, and Aldebaran are each immensely larger than the sun.

ONLY in comparatively recent years has the tomato been recognised as an acceptable article of food. At the beginning of this century tomatoes were supposed to be poisonous, and many men now living can remember when they were grown in gardens as curiosities and called "love apples."

THERE is a tract of land in Levy County, Florida, in which three holes have been dug thirty feet apart, and each excavation has laid bare parts of the skeleton of a hugh animal. The diggers take it for granted that the bones all belong to the same creature and are wondering what sort of a beast it was whose remains underlie the county.

A FINELY-DIVIDED vegetable charcoal is obtained, by a process devised by a Parisian chemist, from saw-dust or shavings (the latter being ground fine) by means of carbonisation in retorts. The charcoal is a superior filtering medium for French wines, whose flavour it greatly improves, and also for alcohol in distilleries.

A REMARKABLE example of the enduring qualities of the daguerreotype is to be found in the old graveyard at Waterford, Conn., (U.S.A). In the headstone that marks the grave of a woman who died more than forty years ago her portrait is inlaid, covered with a movable metal shield. The picture is almost as perfect as when it was taken.

AN arc lamp that combines the principles of the incandescent and arc lamps has been invented in America. One carbon is a tube and the other a round rod, the rod fitting into the tube and being insulated from it by a layer of asbestos When the flanged head of the inner carbon is in contact with the cylinder an arc is formed. The carbons are consumed slowly in a vacuum.

ONE very important cause of deterioration in steam boilers is due to the fact of their becoming too small, as work increases, to do the work without forcing, so that the pulsations of the engine cause a well-marked succession of shocks on the boiler, which result in the weakening of the material. By placing one's hand on the head or shell of the boiler, the vibrations of the metal can be felt similar to the rising and falling of a man's chest while breathing.

THE remarkable degree of perfection to which instantaneous photography has been brought is fully exemplified by the following paragraph: In order to photograph a flying insect, the exposure must last only $\frac{1}{2500}$ th part of a second. This the French photographer, M. Marey, claims to have accomplished by the aid of a new instrument invented by himself. He has also photographed the blood globules circulating in a vein.

IN order to ascertain whether bullets fired from the new German small arms could penetrate a wall of snow, some experiments were lately made at Schrimm, in Germany, with very successful results. A wall of snow, five feet high and six feet broad, was erected, behind which targets were placed. These were fired at, and though the distance was 550 yards, a comparatively large number of shots passed through the snow wall and hit the targets.

THE germ theory is in danger of being overworked. Nearly every disease has been credited to bacilli, and at last human habits and feelings have been analysed in the same way. A scientist, writing to a contemporary, claims to have discovered that the liquor and tobacco habits are caused by microbes, like consumption and influenza. He also thinks there is a microbe of love, and that the reason why a young man's fancy turns to thoughts of love in the spring is because the atmospheric influences of late spring and early summer are favourable to the existence of the microbe. The man who habitually wants to borrow money is, according to this scientist, also affected with a microbe. In short, it would appear that not only all diseases, but all habits, emotions, feelings, etc., are taken into the system with the air we breathe. The only safe way is not to breathe.

SCIENCE QUERIES AND ANSWERS.

A prize of two shillings and sixpence will be awarded for every interesting question asked by our readers and published in this column, and five shillings will be given for every answer published. In all cases when a similar question or reply is sent in by two or more correspondents, the award will be given to the one whose letter is first opened, provided the subject is properly treated. Questions asked by correspondents and not replied to by our readers, may, if of sufficient interest, be dealt with Editorially.

Rules for Competitors.—(1) Only one question may be sent each week, but any number may be answered. (2) Write on one side of the paper only. (3) Envelopes must be marked "Science Queries and Answers," and must arrive not later than the Monday following date of publication.

The following are Answers to Queries published in No. 23.

61.—By what means is the distance between the earth and the sun determined?

There are many different methods by which closely concordant determinations of the sun's distance have been made. Astronomical observations, correlated with the laws of gravity, furnish us with a scale of relative distances of all the important bodies in the solar system. It is only necessary that the true distance of one of these bodies should be determined in order that the distances of all the others may be known. To this end, one of the simplest methods is to determine the distance between the orbits of the earth and Mars. This can be done by a process similar to that used in trigonometrical surveys of the earth's surface. Observations of the angle between a perpendicular to the earth's surface and a line of sight directed to the planet may be made simultaneously at opposite points on the equator. The known diameter of the earth serves as a base line, and we thus obtain all necessary elements for calculating the distance of the planet. Similar trigonometrical observations can be made with respect to the sun itself, although with less accuracy, because of its much greater distance than the distance of Mars when in "near opposition."

62.—By what rule must the composition of a healthy diet be determined?

The most important requisite is the supply of "proteid" or albuminous matter, for the nutriment of living tissues, which, failing this, must be themselves destroyed by their disintegrative tendencies. The supply of proteid matter needed to compensate waste of tissue in a full-grown man of average weight is about 100 grammes per day. This quantity of proteid is contained in: carrots, 9,000 grammes; potatoes, 5,000; cabbage, 3,000; milk, 3,000; rice, 1,250; wheat, 800; white of egg, 750; fat pork, 650; egg yolk, 620; fat beef, 600; fish, 550; lean beef, 480; or peas, 430 grammes. Among other necessary articles of diet the fats and carbo-hydrates (glucose, sugar, starch, etc.) are, in point of bulk, the most important. The proper quantity of these, which constitute the fuel of the animal machine, depends upon the amount of daily work that is expected from it. About 410 grammes of carbo-hydrates and 90 grammes of fats may be taken as a fair average. I give in the following table an estimate of the number of grammes of fat and carbo-hydrates that accompany the needful 100 grammes of proteids in different articles of food:—

	Grammes fat.	Grammes carbo-hydrates.
White of egg	2 ...	—
Fish	3 ...	—
Lean beef	7 ...	—
Peas	7 ...	230
Potatoes	8 ...	1,090
Wheat	14 ...	580
Carrots	20 ...	820
Cabbage	21 ...	220
Milk	107 ...	140
Fat beef	150 ...	—
Egg yolks	200 ...	—
Fat pork	250 ...	—

By the aid of these tables and the rules given it will be easy to determine the proportions of common articles of food which constitute a healthy diet. It should be added that about 30 grammes per day of mineral salts are also needed. But these salts will be largely supplied by the common foodstuffs already mentioned if taken in due variety.

63.—In what circumstances can a photograph be taken with the greatest rapidity by the sun's light?

The best position is at the top of a high mountain, where the thickness of the absorptive atmospheric envelope is least. The absorption of actinism, due to the lower and denser layers of the atmosphere, is remarkable; and there can be no doubt that, by duly considering purity of atmosphere, elevation, and nearness to the equator, situations could be found where, at certain seasons of the year, existing "snapshot" records could easily be broken, and important scientific experiments could be tried.

64.—How often do transits of the sun by Venus take place?

The orbit of Venus lies inside that of the earth—nearer to the sun. Venus also completes her motion round the sun more rapidly than does our earth—in fact, she overtakes and passes us once every nineteen months. If the path of the planet always lay in the same plane as that of the earth's yearly motion, we would be favoured, therefore, with a pretty rapid succession of transits. But this is not the case. The orbits are inclined to another, and "lines of sight" drawn from our planet to the sun, can only cut the path of Venus when we are at or near to those positions in the terrestrial orbit, which correspond to the dates December 7th and June 6th. It is only when Venus overtakes the earth, on or very near to one or other of these dates, that a transit can possibly take place. Now Venus accomplishes thirteen revolutions about the sun in nearly the same time as the earth requires for eight. A little reflection will show, therefore, that after a transit, the lapse of eight years, but not less, will bring us a second time into nearly the same position with respect to Venus and the sun. We might be led to expect from this that the eclipses should occur octennially. As a matter of fact, however, the integers thirteen and eight do not represent, with sufficient accuracy, the relation between the two periods of sidereal revolution. If Venus crossed the centre of the sun, there would be no octennial recurrence of the transit—at the next eight year period the planet would lie without the solar disc. But during the last couple of thousand years there has not been, nor will there be for a thousand years to come, a transit sufficiently central to be sandwiched,—as it were, a hit between two misses. The transits of Venus now occur in pairs, embracing an eight-year interval, and each pair is separated from others, past and to come, by an interval, for transits of similar date, of 235 years. Of course, the dates June 6th and December 7th alternate. The last transits occurred on December 9th, 1874, and December 6th, 1882. The next will take place June 8th, 2004, and June 6th, 2012.

65.—Is it a fact that some animals can see in what is to us darkness; and, if so, what explanation can be given for the fact?

The domestic cat and other animals which are possessed of this power owe it in part to their greater nervous sensi-

bility to what we understand as light ; in part also, in all probability, to an extension of the limits of the visual spectrum.

66.—Are there any important planets between the sun and Mercury?

The existence of Vulcan, which has been called by Prof. Ball "the planet of romance," can almost be said to have been demonstrated, by mathematical analyses of the perturbations of Mercury. Vulcan might be observed during its transit, or during a total eclipse of the sun, and it is said to have been so observed. Since, however, these statements are as yet unsupported by ocular confirmation, such as might, upon several occasions, have been reasonably expected, it is not permissible that they should be recorded as, in themselves, apart from the calculations which have been referred to, of any great importance.

QUERIES.

Replies to the following Queries must reach the Office by Monday at latest; and those selected will be published in the issue after next.

73.—As to the nature of which of the fixed stars have astronomers obtained the fullest information?

74.—What is the simplest method by which perfectly dust-free air can be obtained?

75.—Is it a fact that optical opacity may result from the superposition of two transparent bodies; and, if so, in what way can this be most simply shown?

76.—How is the relative brightness of stars determined?

77.—Why does the electric arc light appear to give a bluer colour than sunlight?

78.—What is polarised heat?

Prizes for Amateur Photographers.

We include among our readers so many who practise photography, both for pleasure and scientific research, that we have decided to start a series of competitions, which we shall continue through the season if the interest is maintained. The first competition will consist of

Six Prizes.

Prize 1.—A Detective Camera, value £2 2s. (by W. Griffiths & Co.), for the best landscape photograph by an amateur.

Prize 2.—A Detective Camera, value £1 1s. (by W. Griffiths & Co.), for the best portrait by an amateur.

Prize 3.—A Detective Camera, value £1 1s. (by W. Griffiths & Co.), for the best written definition, of not more than 200 words, of what constitutes a perfect landscape photograph.

Prize 4.—A Detective Camera, value £1 1s. (by W. Griffiths & Co.), for the best definition, of not more than 200 words, of what constitutes a perfect lantern slide.

Prize 5.—A camera for making enlargements from 12 x 10 plates, value £1 10s. (by W. Griffiths & Co.), for the best lantern slide by an amateur.

Prize 6.—A Handsome Cabinet Burnisher (by C. C. Vevers), for the best photograph (any subject) by an amateur of not more than twelve months' standing—a declaration to this effect must be sent.

RULES.

Competitors may send in any number of photographs, slides, or definitions, but each must be accompanied by a separate coupon, firmly attached thereto.

The last day for sending in photographs, slides, or definitions is Wednesday, June 15th, and they must be addressed to the Editor of "Science Siftings," 78, Fleet Street, E.C., and marked "Photographic Competition."

The photographs and definitions will be adjudicated upon by a competent photographic authority, and the winning prints will remain the property of the proprietors of "Science Siftings."

Unsuccessful competitors requiring their prints returned must enclose the necessary stamps for postage.

The awards will be made known, and the prizes given, on Tuesday June 28th, 1892.

THE COUPON WILL BE PUBLISHED NEXT WEEK.

DEGENERATION AND EVOLUTION.

Mr. H. G. Wells, writing for the *Gentleman's Magazine* says : Perhaps no scientific teaching has been exposed to a greater amount of popular misconception than the doctrine of evolution. In the popular conception, life began with the amœba, then came jelly fish, shell fish, and a miscellaneous mass of invertebrates ; then real fishes and amphibia, reptiles, birds, mammals, and man, the last and first of creation. This is not the teaching of science. On the contrary, biology, along with advance, teaches retrogression as its essential complement. Isolated cases of degeneration have long been known. It is only recently that the enormous importance of degeneration as a plastic process in nature has been suspected and its entire parity with evolution recognised. In fact, the path of life so frequently compared to a steady ascent, an indication of an inevitable tendency to higher and better things, is distinctly repudiated by scientific observers. The sounder view is that living species have varied along divergent lines from intermediate forms and by no means necessarily in an upward direction.

The best known and perhaps the most graphic and typical illustration of the downward course is to be found in the division of the Tunicata. The untrained observer would probably class it near the oyster and the mussel, and a superficial study of its anatomy might even strengthen this opinion. As a matter of fact, however, these creatures are far more closely related to the vertebrata, a fact exhibited in the details of their development. It is a matter of common knowledge that living creatures in the course of their embryonic developing repeat, in a more or less blurred and abbreviated series, their generalised pedigree. For instance, the developing chick or rabbit passes through a fish-like stage, and the human fœtus wears an undeniable tail. In the case of these ascidians (the Tunicata) the fertilised egg cell destined to become a fresh individual follows an entirely different course from that pursued by the molluscs, the dividing and growing ovum exhibits phases resembling in the most remarkable way those of the lowliest among fishes, the lancelot, or amphioxus. The method of division, the formation of the primitive stomach and body cavity, and the origin of the nervous system are identical, and a stage is attained in which the young organism displays—or simulates—vertebrate characteristics. It has a notochord, or primary skeletal axis, it displays gill slits behind its mouth, as do all vertebrated animals in their earlier stages, and the origin and position of its nervous axis is essentially vertebrate. In these three independent series of structures the young ascidian differs from all invertebrate animals, and manifests its high descent from the vertebrates. It is an evident case of retrogression.

Like a tadpole, this animal has a well developed tail, with which it propels itself vigorously through the water ; it has serviceable sense organs, and appears in this, its earlier stages, to be full of vigorous, enjoyable life ; but scarcely is this stage attained before the animal undergoes a process of retrogression. It develops suckers, by means of which it attaches itself to the rocks, its tail is absorbed, eye and ear atrophy, and the skin secretes the coarse inorganic-looking "test," the transient glimpse of vivid animal life is forgotten, and the creature settles down for life to a mere vegetable existence. In some cases the degradation has been a strategic retrogression—the type "stoops to conquer." This is, perhaps, most manifest in the case of the higher vertebrate animals. It is one of the best known embryological facts that a bird or a mammal starts in its development as if a fish were in the making,

and that later the organs get twisted and patched to fit a life out of water—nowhere organs built specially for this very special condition. There is nothing like this in the case of a fish. There the organs are from the first recognisable sketches of their adult forms, and they develop straightforwardly, but the higher types go a considerable distance toward the fish, and then turn round and complete their development in an entirely opposite direction. This turning is evidently precisely similar in nature, though not in effect, to the retrogression of the ascidian after its pisciform or larval stage.

If a zoological investigator could have visited the earth during the upper Silurian period, and with prophetic eye could have singled out the ancestors of man, he would have found them, not among the dominant placoid fishes of the Silurian sea, but in the *Dipnoi* or mud fish, swimming in the pluvial waters, or inert and caked over by the torrid mud. He would have found in conjunction with the purely primitive skull, axial skeleton, and fin possessed by these Silurian mud fish a remarkable adaptation of the swimming bladder to the needs of the waterless season. It would have undergone the minimum amount of alteration to render it a lung, and blood vessels and other points of the anatomy would show correlated changes. Here we have the old story of degeneration over again ; the mud fish had failed in the struggle, they were less active and powerful than their rivals of the sea, and they had taken the second great road of preservation—flight. Just as the ascidian has retired from an open sea, too crowded and full of danger to make life worth the trouble, so, in the older epoch, did the mud fish. They preferred dirt, discomfort and survival to a gallant fight and death. Very probably, then, they would be classed in our zoologist's scheme as a degenerate group. But some of them have risen in the world again ; they came out of the rivers, gave birth to the amphibia of the coal, which gave place presently to the central group of reptiles, from which sprang divergently birds and mammals, and finally the last of the mud fish family, man—the heir of all the ages.

THE CLOUDS A CLOCK FACE.

The index finger of modern science marking time upon the sky! Such is one of the latest conceptions in applied science ; and, as is usual in such cases, we are the first to announce it to the public. We do not know how far the inventor of this bold scheme, Mr. Dickinson, has perfected the optical system it requires. To project a brilliant spot of light upon the clouds—so variously distant as these bodies are—and to wave this luminous index, in rapid sweeps, from zenith to distant horizon and back again, synchronically with the tolling of Big Ben, will not be found a task so easy as the sanguine inventor might be apt to think. It *could* be done, however, with the optical system to which we alluded in last week's SCIENCE SIFTINGS. And we are informed that, if a prominent M.P. had his way, the attempt to furnish London with a clock in cloudland would be made forthwith. It has been suggested that similar means would be applicable to the transmission of code signals by the Morse alphabet. Such a method of signalling might prove to be of the greatest value for military and naval purposes. We understand that experimental apparatus is to be constructed shortly, by Mr. Edwards, the well-known inventor's model maker, of Cowcross-street, E.C.

THERE are 20,000 different kinds of butterflies.

SIFTINGS OF THE STUDY.

Humanitarian Government.

We have just seen the advance sheets of a new work entitled "Humanitarian Government," by Victoria Woodhull (Mrs. J. Biddulph Martin), in which she reiterates the truths that she gave to the world twenty-one years ago, calling forth thereby such persecution, obloquy, and imprisonment, as never before were endured by any woman for conscience sake. Reverting to past American history, she says :—

"Let us see how we have profited by the experiment of Republican Government, as entrusted to the American people. George Washington, in his inaugural address, April 30th, 1789, said: 'The preservation of the sacred fire of liberty, and the destiny of the Republican model of government are justly considered as deeply, perhaps as finally, staked on the experiment entrusted to the hands of the American people.' With his clear judgment he foresaw that it must be at the best only an experiment, and for a long time it was a doubtful one. The Constitution as it now stands was extorted from the grinding necessities of a reluctant people. The wonder to me is, that it has endured so long. It served the purpose of swaddling clothes for the infant child, but it is incompetent to meet the demands of the full grown man and woman of the present. Wider views of the scope of political economy have created a demand for a humanitarian form of government, and this demand will not be satisfied with laws thrust upon a struggling people by ignorant demagogues and political tricksters. The growing needs of the American people demand that scientific education shall be the qualification to decide who our lawgivers shall be, and that the disgraceful corruption at present attending our periodical elections shall no longer be possible."

In another passage we find the following :—"I recently went with my husband to visit more than one hospital and infirmary. My feelings were those of indignation that a community should be so negligent of its duties to itself. At a vast expense these great buildings are kept up, under the care of able-bodied doctors and nurses. Two, and in some cases three, stood over an idiot child of three or four months old ; at another cot, a nurse and a doctor were watching a child with a cleft palate and hare lip ; two-thirds of the children in one ward were, and never could be anything else, than a burden and a tax on the State. It was an exhibition of the grossest ignorance on the part of those who are supposed to be charged with the public weal. Thousands of pounds are expended on these monstrosities yearly ; and the great mass of hard-working people is beginning to ask why the burden of all this ignorance must be thrust on their shoulders.

"I would inaugurate a perfect system of organisation in every district, parish, and borough. I would employ educated men and women, whose duty it would be to find out the physical and mental conditions of every man, woman, and child in each district, and report the same to thoroughly trained officials at headquarters, so that, almost at an hour's notice, the physical, mental, and moral condition of an entire community might be known. I would have an official gazette published regularly with the reports from headquarters, so that the people of each district might know the condition of their surroundings as perfectly as they do know that of their own isolated homes. The Government should employ trained scientific teachers in all branches of education, whose business it would be to see that none remained ignorant on any subject pertaining to their mental, moral, or physical well-being. Trained

nurses should teach every woman her duty to herself and her unborn child, and on the birth of each child its physical condition should be reported in the official gazette. By such means there would be implanted in the parents a desire to have as perfect a physical representation of themselves as possible and even so, should there be born a monstrosity of any kind, the public should be in a position to investigate the condition of the parents, and to find out whether, when they demanded a license to marry, they were both fit subjects for such a purpose. By so doing the people would be made to realise what are the causes to which they owe the ever-growing burden of taxation for the maintenance of the non-effective and useless members of the community."

CRANIUMS AND CRIME.

"Atavism, as described in SCIENCE SIFTINGS," writes a correspondent, Mr. William James, "argues that man descends from the lower animals, when, as expressed, that in the retrogression of the human mind, the tendency is to produce the cranium of the lower animals, Darwinism, etc. The article referred to explains that the physicians who have been studying the relation of the skull to crime discarded the theories of phrenologists on this question as worthless, and without the aid of phrenology to be able to make such (as the article says) remarkable disclosures. But it is worthy of note that all the facts spoken of have been patent to phrenologists for more than half a century, and are embodied in phrenological literature of fifty years ago. We read in the article "that to the casual observer the heads of some murderers are as classical and fine looking heads as the heads of scientists, the divine, or the educator." Exactly; to the casual observer all heads are alike. The four classes of murderers described by the article are acknowledged by the same to possess different shaped heads, and that the wilful and deliberate murderer invariably is the worst type, thus proving that character is known by crania development. Phrenologists do not deny that some are born with a tendency to criminality, but we do deny that some are born murderers; we affirm that it is possible to modify by influence and surroundings the worst-shaped head, and the murderer, who might have been, is taught to find pleasure in the higher faculties while yet in childhood. We recognise no faculty for murder. Murder is the result of excessive activity and inflammation and destructiveness; if we stay the activity and allay the inflammation (both can be easily found and remedied in the child), we cease to produce murderers. Neither does the skull exert certain influences upon the brain, as the writer states, so as to make him a murderer, whether he will or not. Because the skull has no power of itself; the power to shape the skull is given to the brain, even as the power to shape its shell is given to the mollusc. The shape of the skull, as abnormally developed, implies a great activity in that part of the brain; to accept what the article teaches in much that follows is to accept fixed phrenological rules. Thus, in the case of the murderer mentioned, whose skull was said to be of a lower type than that of a monkey, the forehead low and receding, the top of the cranium flat (but not depressed, as stated, by exterior and unnatural pressure, but that there was really an absence of brain, or a shallow brain for the skull to press), the posterior was fully developed. Here is a plain belief in phrenology expressed, when is added, that through the base of the brain being excessively large, the animal nature was the ruling passion. While the facts stated about the same murderer, who was a murderer in his youth and all through his life until he was hanged, would lead us to infer that as he advanced in crime so would his character and skull alter, till when he was hanged there would be a development of propensity, sufficient to cause the writer of "Craniums and Crime" to express that he was a born murderer."

"In the case of the murderer whose head was one bone through the ossification of the sutures, it is stated even then that the brain could and did grow, so that the skull became thin in parts, and the elliptical indentation described, which was probably where the light could be seen through, as throughed greased paper—as I understand that description—fully agrees with the positions of destructiveness that phrenologists locate just over the ear, thus indicating that the murderer could increase his supply of brains in other directions by the same law, the indents being parallel with one or both of the ossified sutures that were thicker at the back, thus giving him less freedom in the propensities than in the intellect where the ossified sutures (in the forehead) were less strong and resisting. The remainder of the article mostly agrees with the theories of phrenologists. It seems a necessity to add that, by such independent methods of research, phrenology can be more fully established, and those who have been seeking to know the relations of the skull to crime, even if they will not see it, have added additional proof to the science of phrenology, and have discovered nothing more than is well vouched for by phrenologists, with the exception of parts of the article objected to, which have caused this to be written."

PALPITATION of the heart is now being treated by the application of cold over the heart—particularly if the trouble is of nervous origin. A wet sponge laid over the heart is a pleasant mode of applying cold; if the patient is in bed, a cloth is wrung out of cold water, and folded to form a compress and laid on the heart; this compress is well covered with dry cloths to prevent wetting of the clothing, and also for the purpose of retaining the moisture.

A Two-Guinea Portrait Free.

The Proprietors of "Science Siftings" will present a beautiful porcelain portrait, free of any charge whatsoever, to every reader of the paper who forwards four annual subscriptions of 6s. 6d. each, or eight bi-annual subscriptions of 3s. 4d. each. These may be canvassed among friends, and a triple object will be served: the friends will be enlightened, "Science Siftings" will be helped onward, and a free portrait secured by the canvasser:

The liberality of this offer will be appreciated when we state that these portraits cannot be procured in the ordinary course of business under two guineas each. They are artistic portraits, beautifully finished by hand, on porcelain panels, measuring the size of this page (10 inches by 8 inches).

Another Offer.

Our object in making this offer is to cause people to talk about "Science Siftings," and thus to promote the circulation. It will be manifest that we lose money by each portrait. This, however, makes people talk about the portraits, and, hence, about the paper. We will, therefore, send to those readers who cannot induce their friends to subscribe to "Science Siftings," a portrait on receipt of 10s. 6d. to cover the cost of the porcelain panel and postage. The portrait will then be free.

Send a good portrait with the order, and the clearer this is, the better the enlarged porcelain portrait will be.

DIGESTION OF ROAST AND BAKED MEATS.

The very general adoption of the close range or "kitchener" in place of the open grate has necessarily caused an abandonment of the method of roasting our meat before the open fire, and the substitution of the process of baking in a close chamber or oven. No doubt the latter method is the most convenient and the most economical, but it may be questioned whether it is the most wholesome. In baking, the meat is, as it were, cooked in its own juices: the vapours exhaled from the warm meat are confined in the close oven, and do not escape into the atmosphere, adding no doubt to the flavour, and also to the richness of the food. At the same time, the joint surrounded by this dense vapour does not yield its juices so freely as when roasted in an open atmosphere, as can be seen by comparing the yield of dripping obtained in the dish in which a leg of mutton has been baked with the amount which a similar joint gives to the dripping-pan when roasted. That a very large quantity of the more oily portion of the fatty matters, especially of the fat distributed between the muscular fibres, does not leave the meat when baked can be shown by examining a slice of baked meat and comparing it with a similar slice of roast meat, when it will be seen that in the former minute oily globules are abundantly distributed among the fibres, whilst in meat that has been well and thoroughly roasted they are comparatively unnoticeable. Moreover, the gravy from baked meat, when cut, always yields more grease than does that from roast meat, though, as above stated, the yield to the dripping-pan is less with the former than the latter. It is pointed out by the *Lancet* that it is this retention of the volatile aroma and unctuous juices that renders baked meat so popular, and no doubt, with persons of strong stomachs, it is not harmful; but when digestion is feeble, we are convinced it is highly injurious, and that its continued use not only aggravates, but also induces indigestion, and that in many instances very considerable benefit has resulted from the advice of the medical man to the patient to order his meat to be roasted instead of baked. Our knowledge at present regarding the respective digestibility of different fats is very imperfect; still, the general and popular opinion is that the more oily fats are less digestible and more "bilious" than the solid, and it is these fluid fats which form the grease of cooked meats. Much the same may be said regarding the mode of cooking bacon. Thus in the north of England thick slices of bacon are placed in shallow tins and cooked in the oven, whilst rashers are usually fried in a pan over the fire. In both cases, however, the bacon is cooked in its own "dip," or most oily portion of its fatty matter. It has long been pointed out that bacon cooked by either of the above methods is a "bilious" article of diet, whereas when bacon is roasted it is not apt to disagree even with decidedly "bilious" people, the reason being that the oily portion of the fat or "dip" is removed, and only the more solid fat left. We have no wish to raise a panic with regard to the useful and economical "kitchener," but would merely suggest that baking may, in some instances, be the unsuspected cause of indigestion, in which case a return to the use of the roasting jack and the open fire would, we think, prove to be a step in the right direction.

An ingenious little invention has been introduced by Messrs. Howard and Co., of 328, High Holborn, for deadening the sound of windows and reducing draught to a minimum. Cheapness, simplicity, and efficiency, are the recommendations of the little "Sash-mute."

ELECTRICITY AND NERVOUS FORCE.

"Wonderful as are the laws and phenomena of electricity when made evident to us in organic or dead matter, their interest can bear scarcely any comparison with that which attaches to the same force when connected with nervous systems and with life; and, though the obscurity which, for the present, surrounds the subject may for the time also veil its importance, every advance in our knowledge of this mighty power, in relation to inert things, helps to dissipate that obscurity and to set forth more prominently the surpassing interest of this very high branch of physical philosophy. We are, indeed, but upon the threshold of what we may, without presumption, believe man is permitted to know of this matter, and the many eminent philosophers who have assisted in making this subject known have, as is very evident in their writings, felt up to the very last moment that such is the case."

Thus wrote Faraday on the eve of his experiments on the *gymnotus*, and, although fifty years have passed, and mighty have been the advances in the mighty power, the obscurity still remains. Faraday's experiments revealed but little, and the subject has since been left to charlatans and pseudo-scientists. Faraday hoped to discover some such relation between electricity and nervous force as exists between electricity and magnetism, or electricity and heat.

Priestly, as early as 1774, held that electricity and nervous force are identical. Dr. Wilson Philip, Matteucci, Prevost, and Dumas all held similar views. But, nevertheless, the identity of electricity and nervous force has not been established, and there is no more absolute proof that nervous force is a manifestation of electrical energy than there is to show that the rope of a church bell is sound. On the other hand, it has not been proved that the nervous force is not an electrical phenomenon, and thus the subject still possesses all of its original interest and importance.

How, then, can the subject be investigated? Let us see what method Faraday employed. That philosopher experimented with the *gymnotus*, or electric eel, and a large part of his work was devoted to proving that the electric current given off by that curious fish was capable of producing precisely the same effects, observed with artificial sources of electricity, and no others; in other words, that the shock of the *gymnotus* is an electric shock. For some reason, Faraday did not carry his experiments further, but he leaves us a suggestion which is of peculiar interest in connection with this subject. These are his words:—"Now, though I am not as yet convinced by the facts that the nervous fluid is only electricity, still I think that the agent in the nervous system may be an inorganic force; and if there be reasons for supposing that magnetism is a higher relation of force than electricity, so it may well be imagined that the nervous power may be of a still more exalted character, and yet within the reach of experiment.

"The kind of experiment I am bold enough to suggest is as follows:—If a *gymnotus* or torpedo has been fatigued by frequent exertion of the electric organs, would the sending of currents of similar force to those he emits, or those of other degrees of force, either continuously or intermittently, in the same direction as those he sends forth, restore him his powers and strength more rapidly than if he were left to his natural repose? Would sending currents through, in the contrary direction, exhaust the animal rapidly?"

Nothing seems to have come of these suggestions, partly by reason of the difficulty of procuring and preserving the necessary specimens. But to study the possible electric nature of nervous force, it is not necessary to go to in

search of eels. The nervous system of any animal furnishes a promising field for research, and this article will indicate, by a number of remarkable analogies, a line of investigation which might, in some degree, serve to dissipate "the obscurity which, for the present, surrounds the subject." The wonders of the human body have often been described and similarities between its various parts and mechanism of man's own creation, have been pointed out; but for a proper understanding of the present subject, it is necessary to go over them somewhat in detail.

The heart is a pump, having valves which force the blood through a system of tubes called the arteries, which ramify to the farthest parts of the body and back again through another set of tubes, the veins. These veins are full of little valves, placed about an inch apart, so as to prevent the cumulative pressure of the weight of the contained blood. The lungs act like a bellows, and in the throat is an automatic valve, which closes the windpipe every time food is taken. The eye is a true *camera obscura*, and the stomach is a chemical laboratory with powers astonishingly varied. Thus the examples might be extended to the bones, which are hollow and round like our modern building columns, to give lightness with strength; hinged joints, ball and socket joints, and combinations of bones and muscles orders.

In all of these cases it will be seen that the agencies and methods used by man himself are not simply analogous, but identical with those found in the human organism. Now to what extent does this hold true of the nervous system? If in every other function of the human body well known methods are employed, are we not justified in expecting to find in the nervous organism a system of communication employing a force with which we are familiar, and which we ourselves have utilised in other ways?

The general similarity between a telegraph cable and a bundle of nerves is so obvious, that long ago electricity was suggested as the possible agent employed, and an examination of the nerves revealed a formation likened to the conductor and insulation of electric wires. But here the investigation seems to have rested.

The analogy of the modern telephone exchange is a more striking and instructive one than is that of the telegraph system. In some of the highly specialised telephone systems there are two wires, extending to each subscriber, one by which messages are sent from the subscriber to the central office, and the other over which the central office sends communications to the subscriber. In the nervous system there is a perfect counterpart of this in the sensory and motor nerves. In case the finger is touched by a hot iron a message of pain is sent over the sensory nerve to the brain, which may be considered the central office of the body. Upon the receipt of this impulse at the brain, a signal is transmitted along the motor nerve to the finger, which is immediately withdrawn from the iron by the proper muscle. In the case of a learner at the piano, the movement of the fingers must be directed in detail from the brain, but after much practice this work is performed automatically by a ganglion, or knot of nerves, which may be considered as a branch office of the brain.

A parallel to this is found in a telephone system, when a number of subscribers, at a distance from the exchange, requires constant communication with each other. The business is at first handled in the main office, but after its nature is discovered a separate small office is established near the subscriber, and the main office is relieved of this work. If the line leading to a subscriber's station is cut off at a half way point, and a signal is sent to the central office, the operator there will naturally suppose that the call comes from the subscriber's station, although connection therewith has been entirely severed. Something like this happens when a man's arm has been cut off and the surgeon makes a bad job of it. The irritation of the ends of the nerves at the stump, which formerly led to the fingers, is supposed, by the central office at the brain, to come from the fingers, and a sensation of pain at the fingers is produced, which is just as real as though they were attached to the body.

It is admitted that the nervous conductor is insulated so as to prevent the accidental transmission of the impulses to its fellows, and certain sheaths have been recognised as performing this function. But in such an extremely sensitive organisation one is justified in the expectation that interfering impulses might be transmitted laterally between nerves, by some means not depending upon contact, as in the case of the telephone system under comparison, where a signal is transmitted inductively between wires separated by several feet of perfectly insulated sheaths.

Now, if such an action is possible, there must be some means adopted by nature to avoid it, and it is here that certain incisions and indentations of the nervous envelopes become of interest, when examined as being possible "anti-induction" appliances.

A section of one of the tin-foil covered conductors, sometimes used in telephone cables, present a striking resemblance to a section of a human nerve.

One of the coverings of the nerve, called the medullary sheath, is found to refract light strongly. This point would bear investigation in view of some experiments, showing that certain manifestations of electricity are refrangible, and also in view of the fact that the theoretical possibility of preventing telephone induction by a method of refraction has been demonstrated. This analogy might be greatly extended, but it is dangerous ground even for the physiologist. Suffice it to say that the number and peculiar shape of the nerve coverings seem too complex to be employed simply to prevent contact.

The existence of this suspected inductive action does not depend upon the identity of electricity and nervous force, but might be a phenomenon connected with some higher form of force which it seemed to Faraday might exist. A study of the nervous system from this new standpoint might produce important results in both physics and medicine. In any event, it furnishes a working hypothesis for attacking the problem of telepathy, as stated by Professor Oliver Lodge. If it is conceivable that one nerve might act upon another without contact, why not one mind upon another without resort to the conventional methods? If it should be found that a peculiar formation is required to prevent "induction" between nerves, the simultaneous absence of that formation in two subjects would be requisite for mind reading. Touching this matter, Professor Lodge spoke as follows at the British Association last summer, and if any apology is needed for treating such a questionable subject it will be found in his words:—"The ordinary processes of observations and experiment are establishing the truth of some phenomena not at present contemplated by science. and to which the orthodox man shuts his ears. For instance, there is the question whether it has or has not been established by direct experiment that a method of communication exists between mind and mind, irrespective of the ordinary channels of consciousness and the known organs of sense, and, if so, what is the process. It can hardly be through some unknown sense organ, but it may be by some direct

physical influence on the ether, or it may be in some still more subtle manner. For brevity it may be styled 'thought-transference,' though the name may turn out to be an unsuitable one after further investigation.

"Further investigation is just what is wanted. There are individual scientific men who have investigated these matters for themselves: there are others who are willing to receive evidence, who hold their minds open and their judgment in suspense; but these are only individuals. The great majority feel active hostility to these researches, and a determined opposition to the reception or discussion of evidence. A few tricks at a public performance, or the artifices of some impostor, and they decline to consider the matter further. The field is the borderland of physics and psychology, the connection between life and energy, or the connection between mind and matter."

CURIOUS TIME CALCULATING.

According to an account of the geography and meteorology of the natives of the cataract region of the Congo, given in the *Mouvement Géographique*, the day is the solar day, in the length of which no variation (the range being only about forty minutes) is recognised. It is divided into four parts of three hours each, which are indicated by stretching the arm or pointing to the east for sunrise; 45° towards the east for nine o'clock; towards the zenith for noon; 45° towards the west for three o'clock; and horizontally towards the west for sunset. Each hour has its name, that for sunrise meaning "early," and that for sunset, "the sun is dead." If a native is asked how long it will take to go to a certain village, he will answer by pointing to where the sun stands at starting, and toward where it will be when the point is reached. Thus he indicates the number of hours by the astronomical angle corresponding with them. Four days form a week, and each day has its name. Public markets are distinguished by the name of the day on which they are held, and of the chief, village, or group of villages that control them. Seven four-day weeks form a month, which corresponds with the lunar month. Long durations of time are expressed in moons; the black does not take account of years. Although he distinguishes the seasons and recognises their periodicity, he has no fixed point by which to determine the revolution of the sun. The five seasons of the Congo are that of abundant and continuous rains (from the middle of February to the middle of May); that of the end of the great rains and the beginning of the dry season, when the grass grows high (middle of May to middle of July); the dry season, continuing to the middle of September—also the season of great hunts; the beginning of the lesser rainy season, when the sapotas begin to grow (middle of September till the end of November); and the season of decreasing rains, or lesser dry season, when the sapotas are eatable (December, January, and early February). The phases of the moon are understood. The new moon is called the child moon, and the moon at its last quarter the dead moon. The blacks know that the new moon is the same that appeared in the preceding month, but they have no explanation for the phenomenon. They have no notion concerning the stars, further than to recognise the brightness of Venus and give it a name, and to name the constellation of the Three Kings. Atmospheric phenomena —rains, droughts, thunder, rainbows, halos, etc.—are attributed to the action of the spirits invoked by the fetish priests.

SOCIAL SCIENCE.

WOMEN IN FICTION.

The most repulsive character in all literature—that of Sin in "Paradise Lost"—is represented as a woman. Milton was prejudiced against the sex, and never did it justice from any point of view. To what extent later writers have been influenced by his example in this respect we cannot surely know, but it is certain, at least, that they have too often echoed his tone of general disparagement. It is only now and then that woman gets what we call a fair show in works purporting to tell the whole truth about her. The heroines of the novels and dramas are, as a rule, only of fragmentary correctness; they stand for conceptions of feminine nature which can be verified only in spots, so to speak. The fact is to be considered, of course, that woman in the abstract is an acknowledged bewilderment, but it does seem, nevertheless, as if those who make a study of her might present her more accurately in the form of individual types. She has been written about in a greater measure than any other one object in the universe, and still it is practically impossible to find her in books and on the stage as she is in actual life. We get mere glimpses where we should have complete pictures, owing to the manner in which the reality is blurred with mistaken fancy and idle conjecture.

It is said that the Greek sculptor was compelled to select from seven models the radiant charms to compose his Venus rising from the sea; and the heroines of literature are necessarily constructed after the same piecemeal fashion. That is to say, the average heroine is a combination of qualities drawn from different sources, and the selections are seldom or never made with consistent and proper discrimination. Thus we are shown an order of women in whom art copies nature only to confuse the understanding, and to make facts have the effect of falsehood by reason of their forced relation to each other. They are true in a sense, but it is a sense that misleads when we come to make application of the knowledge so obtained. We readily discover that the women of our daily acquaintance do not harmonise with these literary characters. Not all of our skill and all of our patience can fit them into a common groove and cause them to have uniform manifestation. The points of difference are fundamental, and we are accordingly bound to see that the ideal is a misrepresentation, or that the actual is fettered by conditions which prevent it from living up to the theory of its existence, and in either event our information is unsatisfactory.

For the most part, the writers are agreed as to the matter of making their heroines beautiful. They consider it a breach of logic, as well as of taste, apparently, to depict a woman who is lacking in attractiveness of face, form and manners. Homely and awkward women are excluded from their calculations. The right of beauty to rule and possess the earth is recognised as an indisputable proposition. They have no use for a heroine whose looking-glass tells her that it is impossible for her to believe herself handsome. The styles of beauty are various, but all marked and potent. Sometimes it is devoted to good and sometimes to bad purposes; but it never fails to have the intended effect. The heroes are so constituted that they cannot resist its influence, and do not seem to wish to if they could. In a word, the beautiful woman is almost uniformly represented to be the woman who brings things to pass, making men supremely happy or abjectly miserable, as she may prefer. She has her way by right of this one precious gift: and other women, not thus favoured of the gods, are obliged to let her take their lovers away from them and play havoc with all their social plans and ambitions. In some instances, it is true, she comes to

their heroines in general terms, leaving particulars to the imagination. Homer, for instance, does not give a catalogue of the charms of Helen; he simply specifies her remarkable beauty by saying that old age itself is astonished at the sight of her, and does not wonder that Paris has brought a war on his country for her sake. It is the same with Shakespeare. His heroines are sketched in outline, and that is all; we are permitted to imagine for ourselves their peculiar points of fascination, and to find likenesses of them among the women whom we know in actual life.

As a matter of fact, the woman whom a man loves is always beautiful in his eyes. He does not consult books for reasons to justify his conclusion; she is transfigured by his devotion to her, and he cares nothing for the views of experts. This is a gracious provision of nature, in the interest of the feminine sex as a sex, regardless of all artistic theories and speculations. It is by no means sure that Cleopatra was as handsome to a tragic and melancholy end, but even then her beauty enables her to triumph at the last moment by being such a charming corpse that death is divested of all its ugliness.

This theory of the superiority of beauty is all well enough as a theory; but its acceptance involves endless clash of opinion and feeling. We have no standard of beauty by which to adjust rival claims and make peace between conflicting elements. When we say of a woman that she is handsome, it is like saying that a night is splendid; if we undertake to particularise we are lost in a vertigo of glittering adjectives. This is the fault of the average author. He takes details from several types and tries to put them together in vindication of an arbitrary personal preference, and the result is a composite woman whose counterpart does not exist. The really great writers are wiser in the matter. They paint everybody else as she was to Antony. The pictures of Mme. Recamier, celebrated for her beauty even when she was wintry-haired and grandmotherly, do not seem to warrant the superlative admiration that she received. We know that Mme. de Stael was ugly, judged by ordinary rules, and that her clothes were always ill-fitting; and yet there were men who contended that she had beauty, and Napoleon feared her smiles more than any sword. The poets and novelists assume a privilege, therefore, that does not belong to them when they insist upon dowering their heroines with given attributes of beauty, and conveying the implication that such is the only genuine article. It is their duty to deal more considerately with a subject that presents so many opportunities for honest and significant differences of opinion.

However, it is not with regard to beauty alone that the average delineator of women is open to serious criticism. He is still more unfair and unkind to the sex in other relations. It is his constant delight to represent that women as a class never reason, but trust wholly to impulse; that they scorn all suggestions of the value of study and reflection, and guess their way through every emergency. The man of experience knows that this is not true. There are frivolous women in plenty, to be sure, but there are frivolous men in equal proportion, and of the two the former is far more preferable. There is more to be said in favour of the intuitive perceptions of the majority of women than the boasted judgment of the majority of men. We see this illustrated every day in the general transactions of society. The liability to mistake is a common misfortune, but it is not true that the preponderance of error is on the side of the sex that is supposed to discard logic and trust to instinct. Masculine vanity stands in the way of the confession of the fact, but the fact is easily discernible all the same.

They set forth, furthermore, that women are hopelessly extravagant and careless of the financial interests of their fathers and husbands. There is no more familiar character in plays and novels than that of the heroine whose demands for funds wreck the fortunes of the hero and drive him to prison or to suicide. We are asked to believe that women, as a rule, have no conscience and no discretion in money matters, when the truth is that they make purchases with a great deal more prudence than men do, and are really entitled to credit for most of the economy that men are said to enforce. The number of men who are ruined by extravagant wives is very small in proportion to the number of those who ought to be thankful that they have provident wives to keep them out of bankruptcy. Not one woman in a thousand will deliberately spend more than her husband can spare, if he will only be candid with her and tell her all about his business affairs. The masculine habit of hiding the facts from wives in this regard is the cause of much of the alleged extravagance of womankind.

Another of the prevailing charges against the fair sex is that it is incapable of looking at any important matter in an impartial way. It decides everything, the cynics say, according to its prejudices, and not according to the evidence. Granting that this is true, can we be quite confident that those prejudices are oftener wrong than right? The feminine mind has a curious knack of anticipating the evidence. It may be mistaken, of course; but, on the other hand, it is very apt to be correct in cases where the best judicial machinery cannot be implicitly relied upon. Nor is it a settled fact, generally speaking, that women are more at the mercy of their prejudices than men. They are more likely to formulate quick judgments, but that does not necessarily signify prejudice. Their methods of analysis are direct and penetrating, and we have much reason for believing that they are, to say the least, fully as exact as the more laboured and pretentious processes of the other sex. What we denominate the judicial sense is responsible for numerous glaring miscarriages of justice. The records of the courts are crowded with proofs of this statement; and in the face of such evidence, it is well to be slow about condemning the verdicts that women render upon questions that touch the honour and welfare of society, as well as the reputations of individuals.

Still another count in the indictment is the allegation of constitutional fickleness. Taking a woman at her word, a sneering critic says, is like taking an eel by the tail. But no man who cares to bear honest witness and to speak from actual experience will indorse such an assertion. The best friends that a man ever gains are not of his own sex, but of the one that he is prone to misjudge and depreciate. In point of veracity, the testimony of a woman is always better than that of a man. They have resources of deception, it must be allowed, and it is well that they are thus blest, since it is often impossible for them to hold their own in dealings with men unless they resort to pretence and strategy.

The traditions and precedents of literature with respect to women are sadly defective; in short, they do not represent the sex as it has a right to be represented. It has outgrown all the excuses that ever existed for the various forms of disparagement to which it is still made subject. The women of the present age are worthy of the sort of treatment that has in it no hint of the old theory of feminine alliance with the powers of darkness. They are not what the current writers say they are. The familiar heroines of fiction are artificial, fantastic, and disappointing. It is time they were taken down from their pedestals and put away with other useless machinery, to make room for women of an authentic description. Let us have heroines drawn from the life that is now being lived, and not from the realm of imagination in which fugitive qualities are

patched together in such a manner as to make truth refute itself and give a certificate of reality to a palpable falsehood.

THE following is the programme for the popular science lectures, at the Victoria Hall, Waterloo-road, for the present month :—April 5th : Henry M. Bernard, Esq., M.A., F.Z.S. "Life in Russia." Illustrated with dissolving views. Chairman, Augustine Birrel, Esq., M.P. April 12th : Dr. A. H. Fison. "The Compass Needle and its Properties. Illustrated with experiments by means of the projection lantern. Chairman, W. Woodall, Esq., M.P. April 19th (Easter Tuesday) : Entertainment instead of lecture. April 26th : Captain Charles Reade, R.N., F.R.G.S. "The British Navy and our Gallant Sailors." Illustrated with dissolving views and a mimic naval action in which a ship will be blown up and sunk by a torpedo. Chairman, Colonel Ford, L.C.C.

IN 1889 some interesting experiments were made in America, on distributing time accurately by flashes of magnesium powder. Signals were thus sent from a station on Blue Mill, Mass., 12 miles distant. They were readily visible, and the exact time to within a fraction of a second could be taken from them. These flashes were also seen from Princeton and Mount Wachusett, 44 miles distant, and from numerous nearer points.

TO INVENTORS.—Anyone having a good Invention can, on applying to the Editor, "Science Siftings," obtain the advice and assistance of a well-known Patent Expert, free of charge.

HELPFUL HINTS:

Being Answers to Correspondents.

Questions to which answers are desired in this column must NOT *be marked "Science Queries and Answers."*

STUMPY.—The growth of the human frame cannot be forced like that of plants. It can, however, be very much hampered. You should abstain from alcohol and tobacco because they spoil the appetite for wholesome food, and you cannot build up a good physique without material. Eat whatever you enjoy and can digest, and take plenty—not excessive—exercise to assimilate what you have eaten. Too much standing is not good, but you must compensate this by keeping early hours. If you are working at the bench do not allow yourself to become round shouldered; keep your shoulders always well back and your chest expanded. Remember that even the sixteenth of an inch makes a visible difference in a man's height, and therefore walk and stand with the head well up and the frame erect. This will naturally assist you to appear tall.

H. MORIN.—Unconscious cerebration may, as you suggest, lead to the development of valuable ideas; and these ideas may find their first embodiment in dreams. Such dreams would demand attentive consideration, but it is our opinion that they are extremely rare. In the instance you mention, we find no reason to suppose that there is any practical value in the association of ideas. In fact, the suggestion made is quite impracticable. We would recommend you to study the first principles of physical science—learning something of chemistry, mechanics, and electricity. You would then be much more likely to originate useful inventions. We may, in the course of a few months, gives a series of educational articles that will be of value to readers like yourself.

E. KENNEDY.—Your suggestion is a good one, and will be kept before us. We are always glad to give publicity to novel suggestions or ideas, but they must be such as to commend themselves to our own judgment, as possible, if not probable, hypotheses. We should be very much interested to learn what ground you have for the suggestion that Professor Airy, the late Astronomer-Royal, expressed doubts as to whether gravitation or electricity was the cause of the attraction between the earth and the moon. You are rather hard on our paragraph, "A Startling Phenomenon," on p. 355. We certainly cannot undertake to vouch for the accuracy of reports of that kind. Permit us, however, to inform you that the occurrence, whether probable or not, is unquestionably possible. It could be explained on the ground that the aerolite, in falling rapidly through the atmosphere, generated a powerful wave of increasing compression below, and left a more or less vacuous track above. The explosion, if it took place in these circumstances with sufficient violence, might be supposed even to reverse the direction of motion of the falling mass. The fragments would then rise, but would fall once more after a short interval.

H. GRAHAM.—To make a magnet take, say three or four yards of No. 18 B.W.G. cotton-covered copper wire, and wind this on to a bar of iron or hardened steel, as cotton is wound on to a reel. Connect he ends of the copper wire to the terminals of a galvanic battery, and he magnet is made. If the bar or core be of soft iron, the magnetism will be temporary, *i.e.*, developed only during the circulation of the electric current. If, on the other hand, a steel core is used, the result will be a "permanent magnet," almost as powerful without as with the circulation of the current. The copper wire may be removed, and the permanent magnet will be found to communicate its properties to needles, penknives, or other articles of hardened steel by simple contact or rubbing. We may add that steel is hardened by heating it to redness, just visible in the dark, and plunging in a bath of oil. If it is desired to bring the steel into the best possible condition for the retention of magnetism, it may next be rubbed with emery cloth to brighten a portion of its surface, and then cautiously heated until this bright portion assumes a blue colour, when the article must again be plunged instantly in the bath of oil and, as before, permitted to remain there until cold.

T. HUDSON.—According to *The Optician*, relief maps are moulded from a mixture of plaster of paris and cotton wool with a solution of glue or gum. We would recommend you to try this recipe.

J. DAVIES.—You say that you gave the windows a fresh *coating* of new putty. We are not surprised that you have failed to make them rain-tight. The glass should be removed from the frames, the old putty scraped from the rebates, and these coated with a layer of soft putty. The glass is then to be embedded on this "cushion" of putty, and the outer coating finaliy applied in your accustomed manner.

YOUNG ORNITHOLOGIST.—We do not know of any paper devoted exclusively to ornithology. We recommend books by Barnsby, price 2s.; Eyton, 5s.; E. Newman, 7s. 6d.; Cones, 12s. 6d.; Smith, 16s.; and Saxby, 21s.

DAVID ANDERSON.—You are quite right. It is the *power* exerted by the contraction of the right ventricle of the heart, and not its capacity, that is equal to one-third of that of the left ventricle. The result is, however, the same, viz., that the power exerted in every pulsation of the heart is equal to, approximately, 2½ ft. lbs. Cases for binding SCIENCE SIFTINGS will, in all probability, be on sale at the completion of the first volume.

RICHARD WILD.—We note your observation made near Bolton on the 17th ult. at 7.30 to 7.50 p.m. You noticed, apparently, an auroral light in the form of four large brushes or streams of bright red glow upon the northern sky. The observations were interrupted at 7.50 p.m. by the intervention of masses of cloud. The fact is certainly deserving of record, which we give to it with pleasure, although space cannot, as a rule, be afforded in SCIENCE SIFTINGS for the discussion of isolated meteorological observations.

FRED GILMAN.—It is impossible, at present, to keep our advertisements entirely apart from the reading matter. If you give your binder instructions to tear off the last advertisement page, it will, however, improve matters a little. The first volume will end at No. 26. We hope to publish cases in due course.

POLARIS.—A "day and night" telescope, having an object glass of about 2½ inches diameter, with an astronomical eyepiece, magnifying from 80 to 100 diameters, would meet your requirements. Such an instrument would define Jupiter's, moon's, and Saturn's rings and moons clearly. A well-made telescope of this description would cost about £5 5s. new, but we have no doubt that you could obtain one second-hand, but equally efficient in optical properties, for about £2 or £3. We would recommend you to advertise for a second-hand instrument through the "Sale and Exchange" column of SCIENCE SIFTINGS.

LERTER FRANCIS.—Thanks for correction. Evolution is a misprint—should be revolution—in reply to E. A. Kennedy on p. 365.

H. LEACH.—Thanks for your appreciative remark. Answers to queries should certainly be free from technicalities.

S. R., JAMES ROBINSON, AND OTHERS.—Please write each answer for the prize competition on a separate slip of paper. We often receive over 100 answers to a single question. Hence it is necessary that all the answers should be classified, and each set read consecutively—a condition which your method of writing them defeats.

T. PARKER.—We shall be glad, when space permits, to record the capture of any *rare* species of insects, by our readers, during the coming summer months. Thanks for what you have sent us; it appears in another column.

ED. P. SMITH.—You will find Huxley and Martin's "Elementary Biology" to be one of the best books for beginners. It is published by Macmillan, price 6s.

SALE AND EXCHANGE COLUMN.

Tariff: First 20 words or less, 6d. Every additional 3 words, 1d. If replies are to be addressed to the office of "Science Siftings," a charge of 3d. will be made for booking and forwarding replies.

Deposit System: To facilitate the transaction of sales between strangers, the purchase-money may be deposited with us. We will acknowledge the receipt of the deposit of both parties, and hold the money until we are satisfied that the goods have been returned or the purchase satisfactorily concluded. When remitting to the Seller, or returning the deposit (if no sale be effected) the following amounts, to cover expenses, will be deducted:—For amounts under 40s., 6d.; for amounts over 40s., 1s. In the event of articles sent on approval not being returned, or notice being given to us within 4 days, the sale will be considered effected, and the purchase-money forwarded to the Vendor.

Exchange: We cannot undertake to receive or forward articles; money, therefore, to the estimated value of the exchanges should be deposited with us.

Remittances, etc.: All remittances must be made either by postal order or halfpenny stamps. Envelopes must be marked "Sale and Exchange," and addressed to the Manager, "Science Siftings," 78, Fleet Street, London, E.C.

The optical lantern in the olass-room. Slides made to order from prints, drawings, etc,, 9s. per dozen. Send print and 12 stamps for sample. Bellyse, Steeple Claydon, Winslow 1

Electric light. Small incandescent lamp; low voltage; a novelty for amateurs. Post free 7d. stamps. P. Rowsell, 1, Walcot-square, London, S.E. 3

Geology. Twenty named fossils, 3s., free; 20 minerals, 3s.; 12 ores, 3s.; 12 ammonites, 3s. Good. Chas. Wardingley, Littleboro', Manchester.

Loud talking machine "Gramaphone" including records (bands, songs, recitations, speeches, etc.). Bargain 21s. complete. Mitchell, Lander-house, Wood Green, London.

Complete lepidopterists outfit, good condition, 15s.; particulars on application. Newman's British butterflies, new, unsoiled, cost 25s., take 12s. 6d. McCleery 58, Townsend-street, Belfast.

Collection of scientific instruments. Telescopes, microscopes transit, barometers, observatory, telephones, Wimshurst machine, microscopic slides, cameras, micrometer, hotometer. List 3 stamps. Hutchinson, Observatory, Liveredge. 2

Twenty-four glass stereoscopic slides. Continental views, statuary palaces, etc. Bargain, 8s., sample 8d. James, Electrician Kew.

Electric motoar, Sieman's pattern, ⅞ in. armatur, armature wants rewinding, otherwise perfect, 12s. 6d. Platten, North, Lowestoft.

Wanted, apparatus and fittings for amateur's electrical laboratory. Samuel Kendon. Goudhurst.

Eleven hundred British moths and butterflies for sale (150 butterflies and 950 moths), 300 different kinds, all good insects and well set. Will sell for £6; worth £18. T. L. Cummins, Clarence-villas, Bishop Auckland.

Wanted, second-handed store boxes, in good condition. W. Hudson, Fulbourn-lodge, Cambridge.

Splendid pair opera and field glasses in case, quite new, cost recently 25s; exchange gold pin or cash offers. Knight, 376, Holloway-road, N.

Field and marine glasses, very powerful, 12 lens, by Archbutt. Cost 120s.; exchange small portable harmonium or anything useful. What offers? C. Parsons, 32, Orchard-place, Clarence-road, Clapton, N.E.

Good binocular glass, field, marine, theatre. Price 12s. 6d., bargain. H. Edwards, Castle-street, Bishop's Castle.

What offers for old antique ship's compass? Pryer, Trimley, Ipswich.

Wanted, a case of mathematical instruments, must be good and cheap. J., Stamp Office, Abergavenny.

Raven's eggs. What will anyone give for 5 raven's eggs, this season's. H. Atkinson, Murton, Appleby, Westmoreland.

Horns of all kinds wanted. Good prices given. A. Henderson, 49, St. Andrew's-street, Dundee.

Giving up photography. Half plate bellows camera, complete. Sacrifice £2. No approval. A. Brown, 31, Evington-street, Leicester.

Photographic outfit, minus camera. Cost £10; offers. Smith, 16, Hamilton-street, Leicester.

Wanted, ½ plate portrait camera, lens and slides, cheap; also cabinet burnisher. Rogers, Swavesey, Cambs.

Wanted, Kodak camera, in good condition. No cards. V. Lea, 8, Windsor-road, Cardiff.

Wanted, 8 in. by 5 in. or 10 in. by 8 in., R.R. lens, Beck's, or any good maker. Particulars with lowest price. Approval. H. Hamer, Beeston-hill, Leeds.

Wanted, apparatus and fittings for amateur's electrical laboratory. Samuel Kendon, Goudurst.

Wanted, an electric bell, working order Exchange; cash if cheap. G. Jaques, Wath, near Rotherham.

Wanted, a powerful horse shoe magnet. E. Goodyear, Radnor Park, Dalmuir, Glasgow.

Solid mahogany cabinet, 10 drawers, few specimens, £1; no reasonable cash offer refused. Exchange with cash, safety. Lucerne Lodge, St. Luke's-road, Clapham, S.W.

Fine healthy larvæ Sambricata (swallow tail moth), eat ivy, 6 for 1s., dozen 1s. 8d. Rev. G. H. Raynor, Panton Rectory, Wragby.

Pupæ of poplar, hawk, and puss moths, reared from the egg, 1s. 6d. dozen. Rowland, South-parade, Chiswick, W.

Splendid field and opera glasses, without case, 8s., little bulged glasses, no worse, cost 50s. new; small pair opera glasses, in case, 4s. Milner, 7, Church-street, Higher Broughton, Manchester.

Eighteen in. celestial globe, splendid condition. Only £4. George Wells, Needham Market.

Surveyor's measuring chain, cheap, or exchange. Vicar, Colerne, Chippenham.

Wanted, surveyor's theodolite, level staff, etc., Elliott's preferred. Rattenbury, Exchange, Bradford.

Two hearts, adult's and child's, injected with wax; dissected hand and harm, showing tendons, nerves, and bones, perfect, dried, and varnished; and a few photographs. Vicar, Colerne, Chippenham.

Large constant current medical battery, handsome mahogany case. £10; price 60s. Approval. Wardell, 9, Grove-place, Ealing, W.

Quantity small British birds, stuffed, unmounted. What offers? Shenton, 7, Park-villas, King-street, Maidenhead.

Will any gentleman exchange eggs, names wanted, for coming season? can supply many good sorts. P. Bunyard, The Nurseries, Ashford, Kent.

Stuffed birds, rare authenticated British specimens, stilt honey buzzard. marsh harrier, bearded and crested tits, etc., well set up. What offers? Dr Green, Ripon.

Collection of eggs, 59 varieties, including chough's eggs, in box, 30s., or offer. Rooth, St. Catherine's, Littlehampton.

Falcon skins for sale: 4 Iceland falcons, young birds good plumage, 25s. each; whiter bird, 27s. 6d.; 2 peregrine skins, males, fine, 7s. 6d. each; also goshawk, 6s. 6d. Apply Edward Marshall, Marlow, Bucks.

Will give splendid ¼ plate photographic out fitin exchange for anything useful, furniture preferred. W. Cowen, Hextol-terrace, Hexham.

New 10 by 8 Taylor, Taylor, and Hobson's landscape lens, cheap. Southwell, Albert-hall, Bath.

Half plate camera, by Fallowfield, fitted 3 double dark slides, all in good condition. Pirce 30s., or exchange. D. R. Spencely, Littleport.

Photo camera, portable, ¼ plate, lot of sundries for same, 50s. lot. S., 17, Settles-street, London, E.

Photographic outfit. minus camera. Cost £10; offers. Smith, 16, Hamilton-street, Leicester.

Living microscopical organisms. Floscularia, Sepranoceros, encrianis, tubes, 1s., with drawings and descriptions post free. John Hood, 50, Dallfield-walk-Dundee.

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SCIENCE NEWS AND NOTES.

"Be a lamp in the chamber if you cannot be a star in the sky."—GEORGE ELIOT.

Is the Child the Father of the Man?

This question becomes most pertinent in view of the criminality peculiar to this *fin de siècle* period. It is something quite new to the generation, and sociologists have come to the conclusion, as has already been pointed out in these columns, that it is the result of the conditions under which our child-life is cultivated. Dr. Francis Warner, the physician to the London hospital, who has undoubtedly had more opportunity for observation than falls to the lot of the average student of humanity, charges the excessive criminality of our country to the ill-advised manner in which emigration is conducted. New countries have been opened up, and the able-bodied flower of the population has emigrated to people them, leaving the residue of ne'er-do-wells to reproduce a generation even lower than themselves in the social scale. The children of this generation, bred up among low influences, cannot evolve into anything save men of stunted intellect and inferior morality.

The State becomes Heavily Burdened

by the defectively made portion of the population, which probably tends to accumulate, as Dr. Warner points out, under extensive emigration, which leaves us the weak, tending to pauperism, starvation, vagrancy, and crime, a large body of "unemployed," and others capable of earning only small and varying wages; the field for recruiting the services is also limited, Were this lower stratum improved, it would pave the way for social amelioration, higher education, better and more valued wage-earning, and less social failure. It must be remembered that these feebly gifted children are confined to no social class, and appear more numerous in the upper grades. The nation collectively is but the aggregate of its components. These observations show the harm that probably arises from exempting the feebly gifted and defective children from all education, because they are unfitted to compete, even in school, with the average and the normal. It is, then, as important concerning a certain locality or sanitary area to know the average condition of the children as the rate of mortality. Mal-developement has been shown, as far as the facts go, to be a potent factor in predisposing to both mental dullness and low nutrition, two evils worth combating. It is not solely for the purpose of attaining a condition of the people with a smaller percentage of badly made heads, palates, ears, noses, or other bodily defects that a strong effort is called for, but that in removing the causes of such defects we may lessen the average of mental feebleness and low nutrition coattendant. The ends which it is desired to attain through State medicine are to improve the average development, nutrition, and potentiality for mental faculty, and thus to lessen crime, panperism, and social failure by removing causes leading to degeneration among the population.

An Important Measure

has just been promoted in the Congress of the United States, and may become law. An exhaustive inquiry has shown that during the past year there have been about 100 deaths of young men, mostly under 16 years of age, from the effects of smoking paper-wrapped cigarettes. In some cases, it is averred, an analysis of the contents of the stomach has been made, and in most instances there have been found phosphorus and arsenic, the latter being a substance, it is said, largely used in the manufacture of cigarette paper. About a hundred men, the report further goes on to say, have been consigned to "insane (*sic*) asylums" from the same cause. Congress is, therefore, being urged to suppress the cigarette by taxing it at the rate of 10 dollars per 1,000, or by imposing a fine on those persons found smoking under 18 years of age, or on those selling cigarettes to such minors.

Arsenic or Phosphorus in Cigarette Papers

would, of course, prove injurious to the smoker, but we doubt their presence. If the paper contained phosphorus in the clementary condition, and in quantity to be injurious, it would impart a twang to the palate of the smoker which we imagine would hardly be relished. Moreover, phosphorus is a very unstable body, and in contact with air would rapidly change into oxidised products, which are highly deliquescent, considerably less poisonous, and if present in large quantity would render the paper quite wet. Why arsenic should be required in the preparation of cigarette paper we are equally at a loss to imagine. The very best material for this purpose need consist of nothing but the purest rice paper. A few years ago stories were in circulation in this country in regard to the noxious effects produced by the smoking of Egyptian cigarettes said to contain foreign substances, and the matter was considered sufficiently important to merit experimental inquiry. This was undertaken by the *Lancet* Sanitary Commission, and the report appears in the number for October 20, 1888. It was reported

that: "The cigarettes which we examined were made from genuine tobacco. No foreign substance, and particularly no opium or other alkaloid, was added. The paper and the cement were pure, the only possible objection being the trace of copper found in the ash, which is probably due to the metallic lettering." If it be true that the paper used as wrappers for cigarettes in the United States are treated with, and contain, phosphorus and arsenic, the remedy is an easy one. Such procedure in the preparation of cigarettes should, of course, be prohibited; and just as articles of food are condemned in this country if they contain substances injurious to health, so should cigarettes containing any substance of a foreign nature be not only condemned, but seized and destroyed. The detection of both arsenic and phosphorus is a simple matter, which every analyst can perform; indeed, free phosphorus could be detected by anybody, since the cigarette paper containing it would glow in the dark.

The Radiant Energy of the Sun

forms the subject of a chapter in a new book by Dr. Charles Moore Jessop, and the author endeavours to show that it is not derived from combustion, since that could only last for a brief period; nor from the falling of meteorites upon the surface of the sun, though it can be proved by calculation that the weight of 1 lb. on the earth is equal to 28 lbs. on the sun's surface, and as the sun's radius is 426,292 miles, the energy of 1 lb. of matter falling into the sun with infinite space would equal that of a 28 lbs. weight descending upon earth from 426,292 miles; supposing the force of gravity to be as great at that elevation as it is at the earth's surface, it would amount to upwards of 63,000,000 foot-pounds. But even this would not be a sufficient source for the continuous heat radiated from the sun. There is, however, another theory of the origin of the sun's heat, that, namely, of the contraction of its mass, and by calculation it appears that, with the present magnitude of the sun, its whole diameter need contract but 220 feet per annum to produce all the heat it now radiates. This contraction will amount to four miles in a century. It is not impossible that the heat of the sun may be the result of the collision and fusion of two bodies moving in space towards each other at the speed of 476 miles per second, which is not beyond that of other stellar bodies. In such case the heat promptly generated would equal fifty million years of the present intensity.

The Age of the Earth

is discussed in a similarly interesting though speculative manner, Dr. Jessop's conclusion being drawn from the thickness of the sedimentary rocks, the denudation from rain and rivers, and other data. The Falls of Niagara, estimating their recession at one yard in one year, have existed 12,000 years. The inundation of the Nile raises the land of Egypt four inches and a half in a century. The antiquity of man, and the gradual development of the faculties, and primitive religion, are also treated by the author. Some of his statements are deservedly questioned by our contemporary, the *Lancet*. Thus, in one place he remarks that in man sight is not impeded by a long muzzle, *therefore* (the italics are ours) the sense of smell is unnecessary to sight. Is not this a *non sequitur*? Again, Mr. Jessop remarks that up to 1,900 years ago a considerable section of the Hebrews did not believe in the immortality of the soul. Hence, the idea of a soul living for ever is a notion of yesterday compared with the duration of man upon earth. Again, we think a *non sequitur*. Other nations may, and probably did, hold the doctrine of the immortality of the soul.

The Story of the Earth

may never be fully told, and most of its particulars, though guessed at with much intrepidity, will probably be held subject to correction to the end of time. But now and then, when the crust of the planet is more deeply penetrated than usual, as when an artesian well is bored, a fragment of the record is disclosed, and all the old and cherished chronologies are irreparably damaged. Such a well was recently sunk at Galveston, Texas, and from a depth of 1,510 feet specimens of wood came up which a learned professor believes to be two hundred million years old. With the wood there were brought up seeds resembling those of the apple and blackberry. Apparently the remains of somebody's fruit farm have been disturbed by the borers; and a considerable interval has elapsed, according to the professor's estimate, since the owner made his last shipment to the antediluvian market. It is but charitable to presume that he has passed it in the company of that shining but extremely select band of glorified horticulturists who gave good measures and whose berries "grew bigger downward through the box."

"A New Power Wanted,"

was the title of a recent article in these columns. In it we made certain suggestions, and we also mentioned that the discovery of such a power would imply a life-long independence for the discoverer. A correspondent, who writes under the name of "Cyrus," tells us he cannot endorse this opinion. He says it *ought* to be the case, but that it is *not*. He then advances the old supposition, that the men who actually originate new ideas die in comparative poverty, and that many valuable ideas which, if developed, would be of great national importance, die for want of means of development, and thus the progress of the world, instead of being helped on, is retarded. This is a most undesirable state of things, but our correspondent is unable to make a suggestion obviating the difficulty, but he hopes that the publication of his remarks in our "widely circulated and valuable paper" may call forth opinions that will do some good. Unfortunately, this state of affairs has existed in all times and ages. Nowadays, however, it is very rarely that a good "notion" is allowed to remain in oblivion. Capitalists are only too anxious to put money into good inventions. SCIENCE SIFTINGS has also done much to help inventors by introducing them to capitalists, but the misfortune is that offers of assistance like ours bring forth so much chaff with the grain, that our work of selecting the good is rendered very laborious. We are, however, pleased at all times to give our advice and assistance when sought.

A Novel Scheme

is under consideration by a well-known engineer for increasing the speed of locomotives, particularly those of fast express trains. It is intended to place an air plough in front of the engine. It will have a sharp edge forward, extending for a few inches above the rails to the top of the chimney. The ordinary resistance of the air to a locomotive is doubtless a very considerable impeding force, and this device, it is believed, will so largely reduce it as to effect a material increase of speed. Possibly, it might also serve in some measure as a shield for the train itself, diverting the blast of wind from the carriage windows, or, at least, those nearest the locomotive. A gain in speed is a great desideratum, but exemption from draught, dust, smoke, and cinders would be even a greater.

Is Electricity Manufactured

by the lighting companies? We recently raised this question in view of some important legislation that has taken place in the United States, but which has not yet been concluded. The judges will have to decide whether an electric generating station should be taxed as an ordinary manufactory. A correspondent now writes to us that it should. We should say not, if the term is used in its ordinary sense and acceptance. A steam engine is not a manufactory: neither is a water-wheel or a wind-mill. All these deal with force, transforming and adapting it to a useful end. But within themselves they manufacture nothing, though they may furnish the motive power by which manufacturing is accomplished. It does not matter, so far as the principle is concerned, whether steam or electric energy is generated. If either is applied to the production of a commodity, we have then a manufacturing industry, but not otherwise. The question is not a frivolous one, nor an abstract speculation merely, but has been raised on very practical grounds, there being a discrimination in the taxing laws of the United States between manufacturing and other kinds of business. When such a distinction is made, it is usually in favour of manufacturing, which all communities are disposed to encourage. Taking the common sense view of the matter, which after all ought to be decisive, an electric station should be admitted to any favour of this kind as much as a mill or a piano factory. Whatever its status may be in a literal or technical sense, it bears precisely the same relation to the public interest, to growth of population and increase of wealth, and should be dealt with accordingly. The law ought to conform, if the lawyers can afford to permit it to do so, to the obvious merits of the case.

Artificial Rain-Making

has not been abandoned by our trans-Atlantic friends; on the contrary, it has been promoted to the position of a commercial enterprise. A Kansas "special" correspondent sends to a New York paper the first report of the local rain market. Two syndicates are already receiving the price of future rain. "Trial rains" can be had for £120. Counties can buy the patent outright for £500, of course on the understanding that wet weather is to be confined to their own area. Showers are offered singly at £120 to the inch. Thomas and Cheyenne counties, to which nature has never quite given satisfaction, think of transferring their entire custom to one of the syndicates, which offers all the rain needed at one cent an acre. These are better terms than Melbourne, the first inventor, offered. It is natural, for the patent has cost the syndicate nothing. Melbourne went off some time since to Mexico, to a mountainous district, where he is said to be perfecting his invention in solitude. In his absence the secret has been stolen by the two companies. At least they profess to have done so, but the New York paper believes them innocent, and they do not seem to have actually produced any of the stolen property in Kansas itself. All they do there is to sell shares, contract for the supply of rain, and receive favourable telegrams from their agents in distant States. One day they receive news that an official of their own has scored 1½ in. of rainfall, under great disadvantages, among the foothills of California. Next day it is a downpour in Arizona. The companies confide the good news to their clients, and the shares go up. The Californian deluge raised them to par. One good shower in Kansas itself would put them at a premium. Some inventors demand one, and we are told that if Kansas were on the warm Pacific coast their demand would be reasonable; but how is a company to make rain at this season of the year, in a climate so cold, so ill-qualified to do justice to the patent, so infinitely better suited for office work? So the shares remain at par, in hope of warmer weather, and in memory of one little drizzle that fell, under the superintendence of Melbourne, many months ago. At the time it was said to be more like mist than honest water, but it is now proved that there was, at least, enough to float two companies.

Another Method for Finding the North

and south without a compass, that can be used with our suggestion for ascertaining the period when the light will serve best for photographic work, is sent us by Mr. C. R. Poingdestre, of 7, Victoria-street, Jersey. He says:—"Let the small hand of your watch point towards the sun; take the half between that and the fig. 12, and from there draw a line across the dial and you have N. and S. For instance, the small hand pointing towards the sun is at 10, draw your line from 11 to 5—N. and S. Again, if small hand points at 4 draw your line from 2 to 8.

To Deal with London Fogs

a queer suggestion has been made by a correspondent, writing to the *Globe*. We quote the letter as a curious example of those schemes which have everything to recommend them except their practicability. It runs: "I would suggest to build six or ten hollow towers round the city in suitable places—the parks for instance—of say 600 feet high, of an ornamental construction. These towers shall be connected at their bases to the drains of the city. Inside these towers are arranged huge grids, on which five tons of coal and coke are always laid ready for lighting. When a fog begins to take possession of the city these fires are lighted, and an immediate current of hot air begins to ascend. As the air must come from the drain connection, there is a violent current towards openings in all parts by the gratings. This air charged with fog being drawn away from the streets, must be replaced by other air, so that in every part there is formed a current toward the drains and so on to the chimney towers. The city air disappearing must be replaced, and so fresh country air rushes city-ward to fill the void, and in an hour the city is purified. The smoke and other impure gases are also drawn in; the height of the towers, with the upward current of warm air, will insure all being carried away from the town. We shall thus have carried off the fog cloud, and also the impurities with which our city atmosphere is charged, and replace it by pure air from the country. The cost of these towers would be more than covered by the saving of the loss caused by five or six days of fog, and seriously lower the death-rate of the city."

What is a Million?

The seven figures which represent one million convey to the mind no idea of the magnitude of one million. But if we take a tape, as suggested by Professor Croll, of 83 ft. 4 in. long, and divide it into tenths of an inch, each tenth representing one hundred years, this tape extended will convey some idea of the enormous amount expressed by the word million. Another method is that of Mr. Nasmyth's, and it is equally ingenious. He shows that sixty columns of the ordinary type of *The Times* newspaper represents about one million letters. Dr. Moore Jessop states that he recently constructed such a sheet, and that, oddly enough, when the sheet was completed, there was a blank space of about twelve inches at the end of a column, which would correspond very nearly with the amount of type required to express the age of the world as ascertained from history.

GLEANINGS OF THE GLOBE.

THERE have been twenty-seven cases of insanity in the Bavarian royal family during the last 100 years.

ACCORDING to Darwin, salt-water fish can, with care, be slowly accustomed to live in fresh water.

CAPTAIN ABNEY, at a recent meeting of the Camera Club, stated that he would rather be styled a "tom-fool" than a scientist.

THE average rate of the several Atlantic currents is 33 miles per diem, some currents running at the rate of 60 miles per diem.

THE last great glacial period is supposed to have occurred about 240,000 years ago, and to have endured, with slight alterations of climate, for about 160,000 years.

DR. PINEL, of Paris, has found that hypnotic patients obey the phonograph as readily as a living speaker. He therefore wholly discards the theory of animal magnetism, and is casting about for a plausible cause for the hypnotic phenomena.

THE first suspension bridge in England was erected in 1741 across the Tees at Middleton. It was 70 feet span, and was erected for the use of miners. It consisted of two common chains stretched across the river and fixed into the rock at each side.

IT now turns out that the Atlantic and not the Pacific is the higher of the two oceans, and that in place of the difference in level being hundreds of feet, as has been affirmed, the surface of the water on the east side of the isthmus is exactly 6½ feet higher than it is on the western side.

IN considering the distribution of organic beings over the face of the globe, the first great fact which strikes us is, says Darwin, that neither the similarity nor the dissimilarity of the inhabitants of various regions can be wholly accounted for by climatical or other physical conditions.

THE Bethlehem Iron Company, Pennsylvania, is to erect at the Chicago Exhibition a full-size model of its 125-ton steam hammer, said to be the largest in the world. It will span the main avenue of Machinery Hall, and will rise to a height of 90 feet. At the last Paris Exhibition great attention was attracted by a similar model shown by the Creusot works, but representing only a 100-ton hammer.

IT is stated by Dr. Chittenden, as the result of some recent researches, that pineapple juice is a most powerful digestive. It has been found to contain not only a milk-curdling ferment, but a proteid-digesting substance, so powerful that three ounces of the juice will dissolve ten to fifteen grains of dried albumen in four hours, this action taking place in acid, alkaline, or neutral media—the latter being the most favourable.

ONE of M. Pasteur's young men has discovered that no living germ of disease can resist the antiseptic power of essence of cinnamon for more than a few hours. In destroying microbes it is not less effective than corrosive sublimate. Even the scent kills them. A decoction of cinnamon should be drunk in localities where typhoid fever or cholera prevails. Ages ago, in the various preventatives used to avert plague and other infectious diseases, cinnamon was a leading ingredient.

ACCORDING to a German journal, a Moscow dentist can grow teeth for us. If this enterprising gentleman would only grow painless teeth for us at the outset, and save us constant agonies from birth to death, he would not only prove a benefactor to the human race, but to his own pecuniary welfare. At present, however, he confines his attention to growing new teeth on the ruins of old ones, which are said to grow as firmly into the gums as natural ones.

A MEDICAL discovery, considered of no inconsiderable importance, was recently communicated to the Paris Academy of Medicine by Dr. Leon Danion, on the introduction of various medicines into the system of animals and men by means of electricity, which he has demonstrated by various experiments on himself. It is through the mucous membrane that Dr. Danion claims to introduce the substance by a method which, if borne out by experience, will revolutionise the healing art.

WROUGHT iron was largely used by the Greeks and Romans, and they seem also to have been acquainted with cast iron, although it was supposed to have been scarcely known to them until recent explorations established a different belief. But, as usually occurs when the relative antiquity of any product or device is the subject of debate, the Chinese come in to throw all competitors out of court. In this case, they are credited with having made use of wrought iron and steel 2000 years and cast iron 400 B.C. They built a bridge with cast iron columns over a ravine 1,000 feet deep in the first century of the Christian era.

A MOST ingenious system exists by which the director at Port Said can tell at a glance the exact position of all the vessels in the Suez Canal, and thus decide how their passages are to be arranged. The director has a model of the canal before him, the whole canal being worked from headquarters by means of the telegraph. When a vessel enters the canal from either end the intelligence is wired to the office, and a figure to represent it is placed on the model. Its movements are communicated from each station it reaches, and, whenever it is necessary for vessels to pass each other, notice is sent to the station, which signals to the particular one indicated to "tie up" for the purpose.

THE Roman soldiers who built such wonderful roads, and carried a weight of armour and luggage that would crush the average farm hand, lived on coarse brown bread and sour wine. They were temperate in diet, and regular and constant in exercise. The Spanish peasant works every day and dances half the night, and yet eats only his black bread, onion, and watermelon. The Smyrna porter eats only a little fruit and some olives, yet he walks off with his load of 100 pounds. The coolie, fed on rice, is more active and can endure more than the negro fed on fat meat. The heavy work of the world is not done by men who eat the greatest quantity. Moderation in diet seems to be the prerequisite of endurance.

SCIENCE QUERIES AND ANSWERS.

A prize of two shillings and sixpence will be awarded for every interesting question asked by our readers and published in this column, and five shillings will be given for every answer published. In all cases when a similar question or reply is sent in by two or more correspondents, the award will be given to the one whose letter is first opened, provided the subject is properly treated. Questions asked by correspondents and not replied to by our readers, may, if of sufficient interest, be dealt with Editorially.

Rules for Competitors.—(1) Only one question may be sent each week, but any number may be answered. (2) Write on one side of the paper only. (3) Envelopes must be marked "Science Queries and Answers," and must arrive not later than the Monday following date of publication.

The following are Answers to Queries published in No. 24.

67.—What purpose is served by dermatic perspiration in the animal economy?

That the functions of the skin, as an excretory organ, are of no little importance is proved by the fact that interference with these functions may lead to serious derangements of the kidneys and lungs. The amount of perspiration excreted in health depends on many conditions, as on the temperature and humidity of the atmosphere, the state of the blood and nervous system, etc. Upon the average, it is considered that about ·7 gramme of fluid is exhaled by the skin per minute, while only about ·5 gramme of fluid is discharged from the lungs in the same time. From ·5 to 1·25 per cent. of non-volatile constituents are found in perspiration. A measurable quantity of carbonic acid gas is also evolved with it, as has been shown by inclosing a limb of the body in a vessel containing air of known composition. In addition, however, to the discharge of superfluous material, evaporation from the skin serves a highly important purpose by maintaining the uniformity of the temperature of the blood. Cold produces an irritation of the walls of the perspiratory vessels, and causes them to contract, so that exudation of fluid is checked. Excessive heat, on the other hand, which stimulates evaporation from the skin, is to some extent compensated by the cold, or rather by the absorption of heat, with which such evaporation is always associated.

68.—What causes the peculiar colour of the planet Mars?

The reddish colour is due to particles of dust, water or ice suspended in the atmosphere by which it is known that Mars is surrounded. Sunlight contains rays of many colours, which may be grouped, for rough purposes, in two classes—blue and red. The blue rays, which are much shorter in wave length than the red, are "scattered" or irregularly reflected in all directions by small suspended particles. By reflection and re-reflection the blue rays are weakened and to a great extent lost. Red rays, on the other hand, can penetrate a turbid atmosphere more easily, and a great proportion of these reach the surface of the planet, and are thereby directly reflected to us with the minimum of loss.

69.—How is the velocity at which light is propagated through the ether of space determined?

The interstellar velocity of light is determined by Roemer's method, based on observations of the eclipses of Jupiter's satellites. The times of the eclipses are known by calculation. The observed times lag behind these, however, for, to use a somewhat loose expression, it is the last ray of light proceeding earthwards from the satellite that fixes the apparent time of its eclipse. This "last ray" has to travel a greater distance when the earth is furthest from, than when nearest to, the planet Jupiter in opposition. The difference is the diameter of the earth's orbit, and this being very accurately known, the speed of light in the ether can be estimated with equal correctness.

70.—Is there any scientific reason for the belief expressed in this saying, "A rainbow at night is the shepherd's delight, but a rainbow in the morning is the shepherd's warning?"

In this country rain is brought most often by westerly winds, which have traversed the Atlantic Ocean, and, the path of these storms being eastwards, it is usually correct to say that rain to the west of the observer is a more unfavourable portent than rain to the east. Westerly rainbows are seen in the morning, opposite the sun, and denote rain in a dangerous quarter. Easterly rainbows, seen in the evening, indicate rain storms that may probably be passing away from the observer. The proverb mentioned is, however, the reverse of true when an east wind is blowing.

71.—What possibility is there of acquiring information as to the surface character of the more distant hemisphere of the moon?

It is supposed that the reason why the moon bends continually the same face to the earth is that at a considerable depth below its surface sufficient heat is retained, or has, until comparatively recently, been retained to permit of the formation of lunar tides due to the earth's attraction. Such tides must tend to synchronise the period of the moon's axial rotation with the lunar month. They must drag the moon round faster or retard it, according as it lags behind or exceeds the rate of motion now observed. But it is believed that matter cooled down to the temperature of space would be so rigid as practically to be unsusceptible to tidal influence. And it is known that the period of the lunar month is increasing. Hence we are enabled to predict that, in the course of distant time, the moon's rotation will no longer coincide with its revolution round the earth, and that the mysteries of its unknown hemisphere may be disclosed to future generations of astronomers.

72.—What is the peculiarity of Halley's comet?

Halley's comet was observed in 1682, and its path was shortly afterwards computed by the eminent astronomer whose name it bears. This computation is remarkable as being the first attempt made in the application of mathematics to the calculation of cometary orbits. The accuracy of Halley's prediction was established by the return of the comet in the appointed year—1758. Historical records prove that Halley's comet appeared in the year 11 B.C., and again in 1066, when it attracted great attention. A picture of this comet forms a quaint feature in the Bayeux Tapestry, as a propitious omen for William the Conqueror. Halley's comet was seen in 1835, and will appear again in 1910 or 1911. The necessary calculations have not yet been made to determine the date with accuracy.

QUERIES.

Replies to the following Queries must reach the Office by Monday at latest; and those selected will be published in the issue after next.

79.—Does the act of digestion of food influence the rate of the pulse?

80.—What is the best method of observing the transit of Venus, and is any useful object served by such observations?

81.—What is colloid material?
82.—Excepting at the poles, could weighing and other operations be carried out independently of the influence of the earth's rotation?
83.—What is the greatest mechanical effect that is practically obtained with a pound of fuel?
84.—Is it possible to voluntarily arrest the action of the heart?

HOW TO FORETELL THE WEATHER.

The reading of the simple meteorological instruments in everyday use are found extremely puzzling by those who do not understand the atmospheric conditions that govern their movements. It is, for instance, very mystifying to the uninitiated to find a high barometer coupled with dirty weather, and fine weather the accompaniment of a falling barometer. An authority has favoured us with the results of his own observations, and we trust they may be found useful by readers of SCIENCE SIFTINGS. The following table explains itself:—

BAROMETER RISING STEADY.

In summer—Fine weather.
In winter—Frost or fog.
In wet weather—Fine weather.

BAROMETER RISING SUDDENLY.

Fine weather of short duration, or N.E. or N.W. wind.

BAROMETER FALLING.

At high thermometer—Wind or rain.
At low thermometer—Snow or sleet.

BAROMETER FALLING SUDDENLY.

In hot weather—Thunder showers.
In cold weather—N.W. or N.E. storm.

Of course, this table only contains the primer of the matter. From earliest recorded times we have had handed down to us sayings which indicate that weather phenomena were noticeable. Every one can call to mind numerous ones, which he has been accustomed to hear from childhood. These sayings are the result of observation, repeated until they become facts. Within the last one hundred and fifty years great advances have been made in the method of observing the weather. The barometer was invented and in a perfected state is in constant use. It is used in measuring the pressure of the atmosphere.

What is the Atmosphere?

Conceive the earth, as a globe, revolving through space, enveloped with air to a variously estimated height. This air partakes of the motions of the earth, and is carried along with it, giving rise to great currents of air, rising and falling, and pressing over different portions of the earth with every varying pressure. Wind is air in motion. It has been noticed that certain meteorological changes occur with certain changes of the wind. These are recorded by the barometer, viz.: In the Northern Hemisphere the barometer falls with the east, south-east, and south winds; changes from falling into rising, with a south wind, rises with west, north-west, and north; and changes from rising into falling, with a north-east wind. Thus it is seen that the barometer rises with west, north-west, and north, and the air is clear and colder; and falls with east, south-east, and south, and the air indicates foul or stormy weather.

The Thermometer.

An instrument to measure the temperature of the air is the thermometer. In this country Fahrenheit is the standard, 32° above 0 indicating freezing point. Now the thermometer indicates the temperature of the air and records the reverse of the barometer, viz.: It rises with east, south-east, and south winds; changes from rising to falling with west, north-west, and north winds; and changes from falling into rising with a north-east wind. Or, in other words, the thermometer indicates colder weather with a west, north-west, and north wind, and warmer with east, south-east, and south.

There are two great currents of air, the polar and the equatorial, which are constantly moving with the earth, and it is the adjusting of these that causes the changes of the wind, and different areas of pressure.

The atmosphere may be likened to the waves of the ocean, and the crests are the "high" and the depressions the "low." Weather then is the result of the atmosphere, under the varying conditions of pressure, temperature, humidity, cloudiness, or clearness, fog dew, rain, or snow

A CURE FOR SEA-SICKNESS.

A cure for sea-sickness is sent to us by Mr. G. Yeate Hunter, East India United Service Club. He tells us that "halviva," prepared from the Indian kreat, has proved very successful against *mal-de-mer*. He believes the reason to be that kreat-halviva acts very energetically on the liver, getting rid of any surplusage of bile. It should be commenced three or four days before embarkation, and continued less often during the voyage. Kreat-halviva is, moreover, a fine tonic and unrivalled restorative. It is now largely prescribed as a safe substitute for quinine in neuralgia, nervous headache, and debility: also in influenza, which would seem to be a malarial disease, as was pointed out by Mr. Hunter in the *British Medical Journal*, May 23rd, 1891.

Prizes for Amateur Photographers.

We include among our readers so many who practise photography, both for pleasure and scientific research, that we have decided to start a series of competitions, which we shall continue through the season if the interest is maintained. The first competition will consist of

Six Prizes.

Prize 1.—A Detective Camera, value £2 2s. (by W. Griffiths & Co.), for the best landscape photograph by an amateur.

Prize 2.—A Detective Camera, value £1 1s. (by W. Griffiths & Co.), for the best portrait by an amateur.

Prize 3.—A Detective Camera, value £1 1s. (by W. Griffiths & Co.), for the best written definition, of not more than 200 words, of what constitutes a perfect landscape photograph.

Prize 4.—A Detective Camera, value £1 1s. (by W. Griffiths & Co.), for the best definition, of not more than 200 words, of what constitutes a perfect lantern slide.

Prize 5.—A camera for making enlargements from 12 x 10 plates, value £1 10s. (by W. Griffiths & Co.), for the best lantern slide by an amateur.

Prize 6.—A Handsome Cabinet Burnisher (by C. C. Vevers), for the best photograph (any subject) by an amateur of not more than twelve months' standing—a declaration to this effect must be sent.

RULES.

Competitors may send in any number of photographs, slides, or definitions, but each must be accompanied by a separate coupon, firmly attached thereto.

The last day for sending in photographs, slides, or definitions is Wednesday, June 15th, and they must be addressed to the Editor of "Science Siftings," 78, Fleet Street, E.C., and marked "Photographic Competition."

The photographs and definitions will be adjudicated upon by a competent photographic authority, and the winning prints will remain the property of the proprietors of "Science Siftings."

Unsuccessful competitors requiring their prints returned must enclose the necessary stamps for postage.

The awards will be made known, and the prizes given, on Tuesday June 28th, 1892.

THE SELECTION OF HEALTH RESORTS.

We have undoubtedly now seen the first glimpse of spring, and we trust it may prove the precursor of a fine summer. Anyhow, at this season the toiler's fancy turns to holiday-making, and, therefore, a few words respecting the selection of health resorts cannot be out of place.

How Climate is Affected.

Meteorology is, of course, the base of all sound climatology. Dr. Theodore Williams, speaking recently before the Royal Meteorological Society, dwelt on the importance of applying the conclusions formed from scientific observations to the practical needs of invalids alluding, first to thermometers, maximum and minimum, as the foundation for climate classification, as it enables us to select such health resorts as are suited to various classes of invalids; one great object being a winter temperature which will allow of exercise, and even of sitting or reclining out-of-doors for prolonged periods. We desire also to note which climates are of great equability, and which of great extremes due to radiation. The first class usually owe their equability to some influence tempering the sun's rays, such as the nearness of the sea, or a large amount of moisture in the air, and this last temper's extremes by diminishing the power of the sun's rays and by forming a vaporous covering to the earth and obstructing thereby terrestrial radiation. As an instance, compare Madeira, where the mean daily range does not exceed 11° F., with Cairo—a desert climate where the difference between day and night temperatures is double that of Madeira—and this difference is still more marked at Luxor, where there is a fall of 17° or 18° after sunset.

Madeira owes its equability to its southern latitude and its ocean environment, its comparately small size causing this marine influence to be felt throughout the island. Cairo has a dry inland climate, with no marine influence to check the fall of temperature from radiation, though the Nile, which absorbs heat in the daytime and exhales it at night, exercises some small modifying influence. In the desert the maximum in winter may be 83° F., and the minimum 38° F., in the same twenty-four hours.

Bask in the Sun.

Sunshine recorders of various patterns may best indicate what daily allowance of outdoor life is possible at a given place for an invalid, and we dwell on the fact that the direct rays of the sun are of the greatest importance to those out of health, and in all but distinctly hot climates should be utilised to the full. We see the pallid cachectic tint of invalidism converted into the brown and reddish hue of good health under this influence, and as we witness its beneficial effects in the vegetable kingdom so in the animal kingdom we believe that circulation, cell formation, growth of nerve and muscle are all promoted by the sun's rays. Thus chilly consumptive patients endure to sit out surrounded by ice and snow in high altitude stations, such as St. Moritz and Davos, where the sun's direct rays, shining through an attenuated atmosphere free from mist, are even more powerful than in low-level stations further south, where the atmosphere is at ordinary pressure, though when the sun sets or is obscured by cloud or snow Arctic temperatures prevail.

Meteorological Instruments.

Tables gathered from observations on rain gauges tell us how invalids may avoid the rainy seasons of a health station, and in the new recording patterns we see how much rain falls in a given time, and can calculate the average number of hours monthly in which an invalid is likely to be debarred from taking exercise by rain, while hygrometers test the more important factor of the dryness of a climate. Some of the most successful health resorts are those where the difference between the wet and dry bulb is large. In the south of France, during a mistral, it rises to 15°, which is excessive, but a difference of 10° is well borne; in Egypt it is often nearly 20°.

Rapid Change is Bad.

What tries an invalid, particularly a consumptive one, is rapid change from great dryness to moisture, as shown in a thunderstorm. A patient of Dr. Williams' was trekking in the Kala Hari Desert, in the Cape Colony, and enjoying the dryness, the hygrometer showing a difference of 25° between the bulbs, when on heavy rains falling and saturation being reached, the patient was immediately attacked with severe hæmoptysis. Except where the bronchial and pulmonary mucous membrane is irritable and secretion scanty, dryness of climate is advisable for most invalids, and essential for many.

No meteorological instrument has been able to inform us accurately why this climate is exciting and that one sedative; why a patient loses his appetite here and regains it there; why an asthmatic breathes freely in one place, and lives in misery in another. But there is, therefore, the greater need for more workers in this field, and for a more complete analysis of the air of health resorts, and especially during periods of epidemics, as well as careful observations with the spectroscope. Chemistry and physics must come to the aid of meteorology.

Some Places and their Climates.

Dr. Williams has sketched some climatic features of the Riviera, from Hyéres to Alassio, as a health resort for the winter months, and noted three factors of the climate (1) the southern latitude, (2) the protection from cold winds by mountain ranges, (3), the warming and equalising influence of the Mediterranean Sea. The Maritime Alps form a good rampart to the north of this region, and chains from them run southward from the Savoy Alps to the Mediterranean, and, trending to the north-east along the coast, eventually join the Apennines; while to the west some spurs extending to Toulon form the Basses Alps, the Esterels, and the Maures, giving a more or less unbroken shelter to the strip of country —in some places a mere ledge—hence the term Corniche, which lies between the mountains and the sea. Some spots like the *petite Afrique*, facing full south, are not only completely sheltered from cold blasts, but gain additional heat from reflection from the cliffs above, though in this case the day is shortened by these cliffs preventing some of the morning and evening rays of the sun from penetrating to the country below. The three chief characteristics of the Mediterranean, the third factor of this climate, are its (1) absence of tides which causes its influence to be always equally potent; (2) its great saltness. The "Porcupine" soundings demonstrated clearly that the Mediterranean water has a greater density than the Atlantic and contains more chlorine, its extensive evaporation causing, probably, this extra salinity, of which traces were detected by Gilbert d'Harcourt in the air 400 metres inland, and at an elevation of 229 feet, and De Coppet detected it by spectrum analysis 1,000 or 1,200 metres inland; (3) its warmth. The sea is warmer than the Atlantic in the same latitude by several degrees; this has been long known, but the "Porcupine" soundings demonstrated that the surface temperature depended largely on the sun's influence, and that there is a uniform warmth of 54° F. from 100 fathoms deep to 1,743

fathoms, the deepest sounding taken—a great contrast to the slow and continuous reduction of temperature in successive depths of the Atlantic, for which Arctic currents are largely responsible.

The Temperature of the Atlantic.

The presence of this warm sea neutralises the effects of radiation on its shores, and Dr. Marcet showed the mean of the sea for November and March was 5·8° F. to 8·6° F. higher than the mean of the atmosphere, while the shore minimum was higher than that of inland places. The sea temperature being 52° F. to 64° F. in winter, it is with due care possible to bathe throughout the winter. Vegetation illustrates this warming influence, and is luxuriant to the very shores.

The Riviera climate is shown to be coldest in December, when the mean minimum is from 42° F. to 46·5° F., and the absolute minimum occasionally shows lower figures. Frost and snow are seen at times, but do not continue for long. The relative humidity varies from 68 to 74 per cent.; the annual rainfall is 31 inches, distributed over about 65 days; but during the winter it is 20 inches in 30 to 40 days, November being the wettest of the winter months. The rainfall increases as we proceed eastwards, the lowest average being that of Hyéres, the highest that of Genoa. The winds are a great feature of the climate, the westerly being dry, and the easterly and northerly the moist ones. The most important is the mistral (north-west), a dry wind, which at Avignon is of great violence, and even at less sheltered spots on the coast is greatly dreaded by invalids. It prevails chiefly in March, and its appearance is the signal for fine weather. The other wind which is feared is the north-east, or *bise*, which is a cold blast from the Maritime Alps, and generally accompanied by rain, or even sleet or snow, but it rarely prevails for more than eight days in the winter, and few of the health resorts are exposed to it. The southerly and easterly winds, which prevail most, are harmless; and though the sirocco in late spring is hot and relaxing, it is chiefly objectionable in winter as a rain bringer. Summing up the winter climate of the district, it is a clear, dry, bright climate, with a good deal of wind; with fog and mist practically unknown, with a temperature of 8° to 10° F. higher than that of England, but subject to considerable nocturnal radiation. There are half the number of rainy days, and four or five times the number of bright ones which we can count on here; and those who complain of the cold and winds of the Riviera should be reminded that these, too, have their beneficial uses, and exercise an aseptic and bracing influence on what might otherwise be too protected and calm an atmosphere.

We trust in the near future to have something more to say on this interesting subject, particularly as regards watering-places nearer home.

THE ROTATION OF THE SUN.

From observations of the displacement of the lines of the solar spectrum, Professor Duner, a Swedish astronomer, has been able to measure the rapidity of rotation of the sun with an exactness hitherto unknown. He finds that part of the surface travels round the axis at the rate of a little more than a mile a second, the solar day at the equator being equal to 25 days and 12 hours of our reckoning. A remarkable fact—possible only with bodies having a movable and gaseous surface—is that the rotation varies in different parts of the sun, diminishing regularly from the equator toward the poles. Near the poles it requires about 46 of our days.

ELECTRICITY IN A MODERN RESIDENCE.

Uses.

The uses of electricity in a residence may be treated under the following heads:—(1) Electric lighting; (2) electric power: (3) electric heating; (4) electric bells, annunciators, etc.

Electric Lighting.

The incandescent lamp is without dangerous heat, is free from odour, absolutely clean, and is controllable at the lamp or from a distant point if desired. Hence the lamps may be placed wherever light is wanted, and we are not limited, as with gas, to a rigid fixture placed in the midst of a large space, and with the lights all necessarily pointed upward. The lamps can be readily placed upon either ceiling or walls, or in recesses made in them for the purpose. The fixtures can be made of any conceivable design, and lamps of any candle-power and colour may be placed in any position upon them.

In lighting a residence with the new illuminant we should dismiss from our minds all preconceived notions based upon the use of gas and oil. Where do we want light? How much? Of what character? and where controlled from? Make such a specification and give it to anyone experienced in such electrical construction work, and the desired result will be obtained in every case.

If we have outside lights they will be unaffected by the weather, and can be controlled from just inside the door. Lights in a cellar or dark basement will be controlled by a switch placed at the entrance, so that the lamps will be lighted before we enter and extinguished after we have left.

Every bedroom, closet, storeroom, etc., will be lighted by a lamp which lights up automatically as we open the door and is extinguished when the door is closed. The convenience of this device can only be appreciated by those who have had experience with it. In many places in the house we shall have a lamp which can be operated either at full candle-power or at very much reduced candle-power at will. In such a house the most timid child of but a few years of age can go anywhere at any time with safety and without fear, lighting and extinguishing the lamps as desired.

In the sitting-rooms we have all the beautiful effects produced by piano lamps, bouquet lamps, fairy lamps, without any accompanying care, danger, heat, or disagreeable odour.

The lamp bulbs will be clear, frosted, coloured, or opalescent, as occasion requires. We shall have, in every place desired, the softest, steadiest, and coolest light obtainable.

The most beautiful effects can probably be obtained in the dining-room and upon the dinner table. Electric candelabra can, if desired, be used, which are identical in appearance with those intended for candles.

The most delicate and beautiful colours in paintings and decorations retain their original beauty indefinitely. The bleaching and blackening effects of gas are wholly absent in the electric light.

It is probably but little appreciated, but entirely true, that the greatest expense due to the use of gas in a handsome residence is in the depreciation of costly materials rather than in the bill for gas itself.

A few years ago there was a probability that the wiring of a residence would, in the future, fail or prove unsuited to the system of lighting which it would be desired to use. This condition of affairs does not now exist. The commercial systems of electric lighting have become as fixed, as regards interior wiring, as have the gas systems; and to-day it is possible to wire a building for electric lamps with a much

greater certainty that the result will be permanent, satisfactory, and suited to future use as is possible in the case of gas piping.

If the building is not to be lighted for some time, it should be equipped with a system of insulating electric conduits which make it possible to draw in any wires desired at any time in the future, or to replace wires previously in use.

Cost.

The first cost of wiring varies widely. An average figure is about half-a-sovereign a lamp, but in many instances it will be considerably lower.

The charge for current is, for an equal light, but little more than gas. The current used is actually recorded by an electric meter.

Electric Power.

The most conspicuous and important application of electricity for power purposes in a residence is for operating a lift. It is possible to-day to have in a residence an electric elevator, both reliable, simple, safe, and economical to operate. There is no noise, heat, or smell accompanying its use. Perfect control is effected by the movement of a small electric switch within the lift itself. No greater luxury than a passenger lift could be imagined, and it has been only very recently that such a luxury could be provided; for, in the case of hydraulic elevators, the water for which was pumped to a tank above by means of a steam engine, gas engine, or electric motor, the complication and expense of attention and maintenance was practically prohibitory.

Other applications of power in a residence are for the operation of dumb waiters, small ventilating fans, ice cream freezers, sewing machines, for the pumping of water, etc.

Electric Heating.

Heating by electricity is, generally speaking, the most extravagant luxury obtainable from its use. Hence the heating of large spaces continually would be out of the question, except where power has but little value. But when we wish a perfectly controlled, safe, instantaneous heat for occasional use, we can obtain it readily, conveniently, and economically by the electric current. For instance, electric flat irons can be operated in a most satisfactory manner by making connection in any incandescent lamp socket. The flat iron in a few second reaches a sufficient, but not scorching heat, and remains at this heat continuously. The cost of the flat iron is not great, and the cost of operating will not exceed a few pence per hour.

Various cooking operations, such as boiling eggs, making coffee, can be performed in a most perfect and convenient manner, and the development of the uses of electric heating for such cooking operations will be very rapid in the immediate future.

Electric Bells, etc.

With the introduction of the incandescent light into a residence the nuisance of inoperative electric bells may be dispensed with. Having a constant source of electric supply we need be no longer at the mercy of the battery which has "run down"; nor will we need the high-priced services of the so-called electrician, who has been with us so much in the past. In a residence having incandescent lamps, our electric bells annunciators, etc., may be made perfectly reliable, and to require no attention whatever for an indefinite period.

Country Residences.

But few such residences in this country are supplied with individual electric plants. Aside from the first cost, the care and expense of maintenance has made such installations very rare. It is now possible to utilise a windmill for an isolated residence plant, so that in an extremely simple manner the windmill will produce electricity for lighting power, etc., etc. A small storage battery must be used to provide means of keeping up the service when there is no wind. Their safety, convenience, and adaptability will make such lighting plants very numerous in the immediate future, especially along the sea coast, where the wind is more reliable than inland.

NEWS AND THE CARDINAL POINTS.

Once in so many years—we have not ascertained the exact cycle of the phenomenon—a controversy arises as to the origin of the word NEWS. Someone who has come upon the stage of active life since the last preceding settlement of the dispute is struck with the felicitous idea that the four letters which compose the word NEWS, also stand for the four points of the compass, North, East, West and South. The fitness and symmetry of the conception are so obvious that it gets into print at once, either as a spontaneous inspiration, or as a resurrection of the statement made by some former champion of the theory, long ago defeated and forgotten. The theory itself is so plausible that it seems impossible it should not be true. News comes from the four quarters of the globe, N., E., W., and S. There you have it, neat, simple and almost self-evident. But immediately there rises up one of those watchful guardians of the truth of whom modern journalism is so productive, and the pleasing fiction is relentlessly punctured. It is shown, with much marshalling of philological data, that the word "news" has nothing to do with the points of the compass; that it used to be spelled "newes" was at one time pronounced in two syllables, is identical with the French word "nouvelles," and in early times meant the same as "novels"—in short, that it comes from the adjective "new," which was begotten by the adverb "now," which is descended from the early English "nou," which had its root in the Greek and Sanskrit "nu," and so on, with most convincing elaboration. This is the close of one period and the beginning of another, during which, as we suppose, the shattered but indestructible fable makes the round of the other planets and at the appointed time comes back to us in all the vigour and freshness of youth renewed. Then, a younger generation having come upon the scene, some member of it suddenly discovers that "news" is spelled N-E-W-S, and puts an announcement to that effect in the public print, usually accompanied with a cut of a weather vane, showing the four points of the compass, and the apparently unmistakable derivation of the word. Then once more the Mentor of the press rises to the occasion, the axe of cold fact is laid at the root of romance, and the world is set right only to go wrong again.

THE GULF STREAM.

Even those who navigate the Gulf Stream do not fully realise the strength of its current. Two or three years ago, a Government vessel was anchored in the stream observing the current. The wind was very light, when a sailing vessel was sighted ahead, drifting to the northward. As she came nearer and nearer it became evident that there would be a collision unless steps were taken to prevent it. The crew of the sailing vessel trimmed their sails to the gentle air; but it was useless, for onward she went, carried by the irresistible force of the current directly toward the bow of the steamer. As the vessels approached each other, by a skilful use of the rudder on board the steamer she was moved to one side, and the sailing vessel drifted past a few feet distant. The captain of the latter was as astonished as he was thankful that his vessel was not lost. All that he could cry out in broken English as he flashed by was, "I could not help it; the water bring me here."

A MYSTERY OF NATURE.

One of the most startling mysteries of nature is the phenomenon known in India as the "Barisal gun." In a part of the delta of Ganges the detonations, that sound as if caused by the discharge of heavy artillery, are heard booming through the air at irregular intervals, rising from none can say where, and caused by none can say what.

They have been heard during at least 400 years, as is proved by local history, and tradition does not reach a time when they were not heard. Nevertheless, they have never been explained.

Heard 200 Miles away.

Barisal is a little town on the western bank of the Barisal River, 65 miles north of the Bay of Bengal. Although its name has been used as though the sounds were peculiar to the place, the noises are familiar to the people of Decca, 75 miles northward. They sometimes occur at Chittagong, 100 miles eastwardly, and occasionally startle folk at equally great distances away toward the west and the south. They have even been heard with great distinctness at Cherra Punji, which is nearly 200 miles north of the Bay of Bengal.

Various Explanations.

At times they seem to come from the south or southwest; and again from the north or east. Wherever one hears them they always seem to come from somewhere else. No one has ever been known to be near to them, but they are never so remote as to leave doubt in the minds of those who hear them that they are actually the sounds of cannonading. The natives, ever ready to explain what they do not understand by giving it a supernatural origin, have two versions of the cause of the detonations: One, that they are the sound of the opening and shutting of the brazen gates of the mythical palace of Ravana, on the island of Ceylon; the other, that aerial beings—Devalas—produce them by the firing of ghostly cannon in honour of Ali, Khanja, or Khan Jahan, who was Tansildar of Bagirhat, 400 years ago.

Pooh! Pooh!

Of course, when matter-of-fact Englishmen got into the country, they said, "Pooh! Pooh!" to all that, and straightway set to work to find scientific explanation for the sounds.

But they have to admit that they have not yet found it.

Col. H. S. Olcott, after devoting much inquiry and study to the matter, averred that so far as he could see the ghostly artillerists of Indian story were as probable as anything that the most advanced modern science could suggest and maintain by way of explanation.

Now, during more than a year, the Asiatic Society of Bengal, after collecting and studying the facts, finds these mysterious aerial demonstrations as deep a puzzle as ever.

Not an Echo.

Fully to appreciate the strangeness of this phenomenon, it is necessary to understand something of the country in which it takes place, and the conditions under which it is heard. The land in all the district mentioned is a flat, alluvial plain, intersected by a network of almost innumerable streams and channels of the sacred Ganges. That is the general character of at least 50,000 square miles of the deltas of the Ganges and Brahmapootra rivers. The nearest hills are a hundred miles away from Barisal, toward the east, and nearly double that distance north-westwardly, so there is no basis for an "echo" hypothesis, if even it were possible to find anything that might cause such echoes.

Nor Atmospheric Electricity.

There are no military cantonments, and no heavy guns in all that part of the delta where these noises occur, so they can not be caused by real material guns.

The detonations are always heard at their best in the clearest and dryest weather, and never during storms, so atmospheric electricity can not reasonably be held responsible for them.

They have not been known to occur simultaneously with earthquakes.

The attempts at explanations are in many cases rather amusing than satisfactory. If certain things are true, which are not true, more than one of these explanations might be thought not wholly improbable. But, as the explanations are positively contradicted, by facts, it is not even worth while to mention them.

Will they Solve it?

All over the territory in which this phenomenon occurs, the Asiatic Society of Bengal has caused to be distributed printed lists of questions and blank forms, to be filled out with data which it is hoped will, when collected, sustain some hypothesis, or demolish by unquestionable evidence all that have been or may be advanced.

Hundreds of the most intelligent residents in the district are gathering the desired facts. Should the society succeed in finding a physical cause for this acoustic marvel of the centuries, it will have solved one of the most puzzling problems ever propounded to scientific men.

ELECTRICITY is to be brought to bear in reducing the labour of cutting ice in America—it is to do away with ploughs and saws. A wire will be stretched along the ice, and kept red-hot by a battery. Thus heated, it will sink into and cut the ice very rapidly, and much cheaper than by the present method.

A Two-Guinea Portrait Free.

The Proprietors of "Science Siftings" will present a beautiful porcelain portrait, free of any charge whatsoever, to every reader of the paper who forwards four annual subscriptions of 6s. 6d. each, or eight bi-annual subscriptions of 3s. 4d. each. These may be canvassed among friends, and a triple object will be served: the friends will be enlightened, "Science Siftings" will be helped onward, and a free portrait secured by the canvasser:

The liberality of this offer will be appreciated when we state that these portraits cannot be procured in the ordinary course of business under two guineas each. They are artistic portraits, beautifully finished by hand, on porcelain panels, measuring the size of this page (10 inches by 8 inches).

Another Offer.

Our object in making this offer is to cause people to talk about "Science Siftings," and thus to promote the circulation. It will be manifest that we lose money by each portrait. This, however, makes people talk about the portraits, and, hence, about the paper. We will, therefore, send to those readers who cannot induce their friends to subscribe to "Science Siftings," a portrait on receipt of 10s. 6d. to cover the cost of the porcelain panel and postage. The portrait will then be free.

Send a good portrait with the order, and the clearer this is, the better the enlarged porcelain portrait will be.

DIVINING RODS.

Our recent article respecting the philosophy of divining rods has attracted much attention, and at the present moment there is a wordy warfare rampant in the columns of a contemporary between those who deny and those who believe in the alleged facts. We have elsewhere expressed our own opinion on the subject. We now publish some particulars about the construction and use of divining rods, supplied by a Freneh seientist, M. Vinassa.

How Water was Found.

The wood employed for making M. Vinassa's rod was a branch of *populus italica* (poplar tree), 90 centimetres long, bifurcated at a distance of 0·40 m. into two other branches each measuring 0·50 m., equal to obtain more perfect equilibrium. The thickness of the branch was that of the little finger, but a straight rod, cleft to nearly the extremity, could also be used, and the two ends thus divided should be held, horizontally in the hands. Experiments have been limited to researches for springs known to exist. M. Vinassa knew of a subterranean stream of water which crossed his garden longitudinally. Holding the rod in his hands drawn close to his sides, and in a horizontal direction, he directed his steps toward the current of water, so as to cross it. Arriving at a distance of one metre from the water, the points of the rod he held in his hand pressed against his fingers, and the other extremity, unconfined, rebounded and struck him violently on the head. This preliminary experiment proved nothing, in substance, as, being acquainted with the presence of the water and suspecting the action of the rod, he might unconsciously have made the movements necessary to produce the straightening of the rod.

Nervous Temperaments Best.

He recommenced the experiment with his eyes bandaged to deprive himself of the precise notion of the spot where the current was situated, and the phenomenon repeated itself identically in the same place. He renewed it with persons who were neither acquainted with the ground, nor the subterranean current, which, moreover, did not betray its presence by a more luxuriant vegetation, as is often the case. Among the persons who subjected themselves to these experiments, some were sick, delicate, and not of a nervous temperament. With them there was no result. Those endowed with a nervous temperament were very good subjects; and among them, in the case of one young man, having nervous irritability in a high degree, the rod rebounded with such violence as to break in his fingers. The fact duly demonstrated, the laws were to be found. In the first place, the nature and condition of the wood only affect its sensibility. Those most adapted to this species of experiment are the nut-tree and the poplar, to which, according to one authority, the alder-tree is to be added. Short rods work better than long, probably the *vis inertiæ* is less considerable. The rod generally raises itself, but sometimes also it falls, according to the person who holds it. In the vicinity of a water current the rod moves at an almost uniform distance, which varies slightly with the experimenter. Its movement forces the hands to turn on themselves as though the centre of rotation was in the thumb. It is the rod which makes the hands turn, and not the hands the rod, for if it were so, the hands even without this rod ought to turn on a current of water, which never takes place.

The Cause of the Phenomenon Sought.

In order better to understand the conditions of the mode of the rod's movement M. Vinassa made the following experiments. After marking with great accuracy the points of ground where the rod began to experience the action of the current of water, he walked in this direction holding the rod, with his hands stretched forward instead of by the sides. When the hands holding the rod had entered the sphere of activity the rod remained motionless, and it did not begin to move until the operator had in turn entered. This fact would seem to prove that the impulsion is only communicated to the rod by a current from the human body, and this only takes place when the body is really in the part subjected to its influence. Placing the rod in communication with the ground by a metallic wire the phenomenon reproduced itself in identical data, and by introducing a very sensible galvanometer into the wire the latter gave no trace of an electric current. But another experiment remained, more decisive in character, to endeavour to demonstrate the cause of these singular movements. Instead of holding the rod in the hands one had to see whether, by holding it through an intermedium (a good conductor of electricity or not), the rod would continue to move. Firstly, M. Vinassa placed the two free extremities of the rod in two metallic tubes. They were two large-piped keys, and the rod rebounded sharply at the instant when the operator crossed the stream. Introducing, on the contrary, the extremities of these branches into a glass tube, carefully dried, so as to take away all trace of humidity, which might act as a conductor, the phenomenon completely disappeared. It might happen that, the tubes not perfectly embracing the rod (it was difficult to find them of the same diameter), the mechanical communication was defective. In this case the slight oscillation of the apparatus could not manifest themselves. The author then replaced the glass tubes by very dry and well pressed bands of wool. The insulation was complete, and there was no movement. The oscillations began again, but rather slight, after damping the wool bands, to make them conductive. They also took place when M. Vinassa operated on a table placed over the stream, and isolated from the ground on glass feet.

A Useful and Pleasant Study.

Such are some of the experiments made with the divining rod. They are far from complete, and it would be imprudent to draw premature conclusions. But experiments are easy and the appliances inexpensive, as one sees, and there is no great difficulty in reproducing them wholly or in part. M. Vinassa points out that this demands a nervous temperament, and all who try the experiment will not perhaps succeed. This failure will have at first the advantage of settling the character of the temperament, but by looking about it will be easy to find persons—men or women—who are in the proper condition for the experiment. This study will be both useful and pleasant; for not only will it enable the mechanism of the phenomenon to be accounted for, but also may reveal the true cause. But the knowledge of a secret of nature is well worth the time and labour devoted to its attainment.

Electricity has been tried in Sweden for blasting. A deep hole is drilled in the rock and a Jablochkoff candle is inserted and the current turned on. The intense heat causes the rock to swell at all points, and internal strains crack the whole rock. Holes are best drilled into the solid parts, not, as in blasting, in the seams and soft places. Such a mode of blasting would avoid the dangerous use of powder and other more violent explosives when employed in near proximity to dwellings, as is often done in this country, with dangerous, and sometimes fatal results.

SOCIAL SCIENCE.

THE SENSE OF NONSENSE.

Can we always be expected to exercise common sense? We ask this question in the interest of all classes of people, and do not see that there are any who are beyond the need of an apology for occasional nonsense. We have never seen nor heard of any one who did not occasionally act like a simpleton—perhaps needed to so act. For our part we believe in kicking up the heels, up to old age, and being as merry on occasion as a rustic at a country dance or a city apprentice at a circus. The more rigidly wise a person always is, the less wholesome and useful. When you have done a good bit of metaphysical thinking get among the children and play—like a child. If you do not you will soon be unable to do sound thinking of any sort. Your ideal college professor is not the one who is always dignified, reserved, and ready for the interviewer of a religious newspaper; but the one who is off guard one-quarter of the time, plays lawn tennis and gets wild over the boys' games.

Five Hours' Thought.

The fact is we have created a false standard of character and quality. When we gauge a great man we look him all over for flaws and foibles, and if we find any we describe him by them instead of by the real bulk of his manhood. The truth is we should make allowances for a certain percentage of foolishness in the best men; say one-quarter in a down-right, first-class, able thinker, or one-tenth in a prime business man. We should allow more, or for more, in proportion to the original thinking done. The greater a man is, allow for a larger percentage of nonsense. You say this is not reasonable; that a wise man should be wise all the time. On the contrary, he ought not, and you ought not to expect it. If you can get out of a man five hours of solid thinking in a day you have done wonders; and so has he. The rest of that day you need not be surprised if he talks like a fool and acts like a circus clown. Anything but crawling off into a corner to smoke himself into a condition of smoked herring. Let him prance, yell, squeal, kick up, roll on the grass, say silly things. You have no more right to judge him out of harness than you have the pulling power of a Percheron when in pasture.

Disagreeable Nonsense.

Don't mistake us—the nonsense in a very able man does not always work itself off in pleasantry. Our friend Hodge is broad-shouldered, solid, sound-headed and naturally pugnacious as a bull. He is capable of a marvellous amount of sound, first-class literary work; and while doing it shows no sign of inflammability. That is, he is not controversial; treats his antagonist justly, but when worked out, then you keep away from him. He is positively ugly; would as soon fight a duel as not. This is his manner of nonsense. Do you mean to set him down as a fool, or discharge him from the world's workers? Well, we cannot get on without him and many more of the same sort. You must let him tear around, paw up the ground, not tease or worry him, and he will soon quiet down. "What!" you say, "are you going to allow a man to act like a beast and not say anything about it?" There is a great deal of beast in all of us, dear critic—a great deal of old animal, which is the modern word for old Adam, and it must be very judiciously dealt with. You cannot go on battening down all the beast in man. Society is not built up that way. Our social institutions all are compelled to fit themselves to the brute side as well as the higher side of humanity. There is not one social or civil institution that forgets to do this; only Utopians demand perfection. You must certainly let our friend tear around reasonably, and don't get in the way. Half the mischief in the world is done trying to stop mischief. Domestic quarrels in families of a low grade you must not meddle with, unless you wish to have them both turn on you. It is somewhat so in all grades of society. There are but few who have not at times their cross moods. They are not accountable. If they could be explained they could be reasoned about. We know we are at the time foolish, irrational, unreasonable, liable to do something silly, or worse. The best thing under the circumstances is to withdraw to our own companionship. We should not be worried and badgered. We are entitled to be foolish if we like. Let us come to in our own way. We shall be sorry enough.

Know Your Man.

It is very hard that other people should get a glimpse of us in an off mood and set us down for fools or other knaves. Of all things we make our study of men most one-sided, but of all things man is the most many-sided. If we study a tree we go all around it, and then again and again, and we look at the top as well as the trunk, and the trunk as well as the top, and we examine carefully leaf, bark, flower, fruit. What a silly thing it would be to judge by the bark only, or by the flower only. A blackberry is the most reasonable berry under the sun and the best, but what a ferocious bush it grows on! Now, a man is entitled to be understood in the same way. You should go all about him and study him from all approaches. A rough bark or a few thorns may be as much a part of human evolution as of elm or blackberry evolution. You will bear in mind that it is not so *very* long ago that our eye teeth were tusks, and we survived as "fittest" by tooth and nail. It is not to be expected that we should have quite grown out of all our long-tooth instincts. The true way to judge a man is to say what a wonderful piece of progress is here! How grandly he has escaped the savagery of his ancestors! See how he has shortened his tusks! See how he pares his nails! See how he has turned his snarling muscles into laughing muscles! Really he is no longer dangerous. He has given up a part of his body defences. He has developed moral force! He has become nine-tenths moral and rational. Only *one-tenth* of him is now any longer brutal and foolish.

The Social Layers.

Man is still in the making; may, indeed, be said to be the most unmade animal on the globe. Most of the rest are finished, having little improvableness about them. Is not, therefore, the real question to ask about any person this; Is he improvable? Is he improving? Is he anxious to improve? If you must set down the reply in the negative it goes hard. But have never seen a man quite of a hopeless sort. However, we are not so anxious just now about these uttermost sorts as about the uppermosts, or the midmosts. Some other time, to be sure, we ought to talk about the bottom layer, and see that, if they were not there, some others would be; and if in turn you remove the average fellows, the topmost will be all that are left; and they will be at the bottom because nothing is below them. That is, the best of our stock is only a grade of the general evolution, and high only by contrast. The absolutely deanimalised person is not findable. We are only so many stages of progress. That is why we should praise the achievements more than blame the failures.

Dangerous to be Funny.

Quite too little is made of the law of action and reaction in the study of human nature. The very best efforts that can be put forth for virtue lead to enfeeblement and exhaustion; and so the chances are there will be a temporary lapse

into the vulgarity of vice. "It is a dangerous thing," says Dr. Oliver Wendell Holmes, "to be as funny as you can." It is, we say, dangerous to be as good as you can. Don't you touch a minister after he has preached a really noble sermon. Don't cross him! Don't criticise him! He is exhausted of goodness and will be surely soured, or else depressed and disheartened by your adverseness. He will say things very unpleasant and quite out of harmony with his discourse. We should not be surprised if he was at once in a rage, and made you give up all your good opinion of him as a holy man. The man is suffering reaction. You ask too much. You expect him to be ideally right all the time, whereas by the law of nature he must be lacking in common sense a part of each day. You require too much of him. Others turn on you in the same way, and so there is great discord that is caused by our not understanding how to judge human nature by making no allowance for reaction.

Review Yourself.

You can see that the general principle we are expounding explains the unfortunate failures of great men. Napoleon was a fool more than his just proportion of time; and he had a habit of sticking to decisions made in his off hours. You may bear this in mind, that the wisest man is he who most often and freely contradicts himself. To never veer in judgment, and never go back on yourself, is not a mark of genius. That is, a wise man is one who reviews himself as often as once a day; and then perhaps again each week. If you have a possible controversy, and have written a letter, be sure not to send it for twenty-four hours, giving yourself time to reconsider it. Perhaps a good rule is to let all letters lay by for a day, if possible. You may have written one in your fool hour. You will be surprised at least that you could have said some things, or proposed others.

Be a Fool Sometimes.

Is love in and of itself silly? We are quite sure you will say that the underlying principle is a very wise one, and very noble. But how immensely funny much loving is; how illogical; and really a little off. The world makes fun of love and lovers, but never has an idea of abolishing it or reforming away from it. A misanthrope is a miserable fellow. We know he, too, is off his balance. So you see that not to love is proof of a lack of common sense; and really any little common sense is shown in the spoony period. The reason is precisely that we cannot be expected always to be reasonable beings. Reason is something we can make good use of a part of each day, and only a part of each year—besides there are fool periods in life that no one quite avoids.

A Very Foolish Fool.

It is the privilege of the man of work; indeed, it is his duty to play. All the world is finding this out. Such a thing as a vacation was not known fifty years ago. We buckled on the harness as soon as we left school and began our "life work." Men were bent and worn up to the handle at 50, and decrepit at 60. Now vacation is an institution of civilisation. The problem for us to solve is just what proportion of time a person should keep mind and body harnessed, and how much unharnessed, in order to achieve the very best sort of life; and the longest one, with the most freshness, comfort, elasticity, and usefulness. Possibly some vacations are the hardest part of the year. And there is, there really is such a thing as being a very foolish fool. Perhaps the proper test is whether we are stronger or weaker, better or worse, and have more ability to make ourselves useful to the world.

HELPFUL HINTS:

Being Answers to Correspondents.

Questions to which answers are desired in this column must NOT *be marked "Science Queries and Answers."*

SWALEDALE.—If Mirabeau was not born with the "birthmark of hate" it was certainly something akin to it. Surely his turning against all the noble traditions of his class is an exemplification of this; his opening a cloth merchant's shop was most probably a petulant defiance of the aristocrats. None deny that he was a brilliant orator, and although a fickle politician he was yet a chivalrous one—not, however, beyond purchase. An unfaithful friend, a cruel husband, and a brutal father, withal a disinterested philanthropist. Who knows whence this birthmark of hate? Perhaps the bitterness may have originated with the pock marks that disfigured his face from three years of age, and which must, undoubtedly, have brought him ridicule from his schoolfellows; or, may be, the despotism of a capricious father may have embittered him against people and things. It is, however, unjust to class Mirabeau with Robespierre or Marat.

L. ARTHUR LANCASTER.—(1) Dumb-bells should be used in the morning. and certainly after, not before, the bath. (2) To correct sloping shoulders, gymnastic exercise, as practised in the army, should be supplemented by the wearing of a shoulder belt. (3) The reason why chlorate of potash is more readily decomposed by heat when admixed with dioxide of manganese, is, probably, that the manganese is capable of undergoing a higher degree of oxidation, but that the higher oxide is, in its turn, very readily reduced. If so, the part performed by the apparently inert material, consists in first taking up oxygen and then setting it free again. Finely divided platinum also facilitates the decomposition of chlorate of potash, and, in this case, the effect is known to be due to the temporary occlusion of oxygen in the pores of the particles of metal, which particles themselves undergo no change.

BONNYRIGG.—To cement indiarubber to leather, wood, or cloth use a solution of pure indiarubber (that has not been vulcanised) in bisulphide of carbon. When rubber is to be cemented to a polished metal surfaces, it is best to give the latter a preliminary coating of spirit varnish. To cement gutta-percha, a solution of gutta-percha in bisulphide of carbon may be used. In either case let the joint be submitted to pressure, which is not removed until the cement has become thoroughly dry.

H. SUMMONS.—To cleanse the bones of animals (for preparing skeletons) submerge them in spirits of turpentine, in a vessel so deep that the bones may be wholly covered with liquid, while raised, by at least an inch, from the bottom of the vessel. Permit them to remain undisturbed for a week, at the end of which time they should be deodorised, and the traces of fatty matter extracted from them by the turpentine should have subsided to the bottom of the vessel. The bones are now to be well washed with soap and water, and soaked for an hour in a solution of chloride of lime, to which a few drops of nitric acid has been added. After washing in water, and drying, they are now ready for mounting. Holes for the insertion of the wires can be drilled without difficulty; and these can be fixed in place with a cement composed of plaster of paris and weak glue water. Your question how to calculate the magnifying power of the microscope is rather too indefinite. State fully what description of microscope you refer to, and we will give you the required information.

YOUNG ORNITHOLOGIST.—You will find *The Feathered World* of great interest to you, since you require a paper devoted exclusively to ornithology.

A. LEWIS.—The opinion of Sir James Crichton Brown that between the years '65 and '75 there has been an increase in the death-rate, is no doubt based on reliable statistics; and as you now see, the statement is not in discordance with the general increase of longevity. The impression we convey that crime is seriously increasing in Europe is correct—we do not say in Great Britain, where it has decreased. See reply to "Swaledale."

FRED W. FULLER.—The seven wonders of the world were: The pyramids of Egypt, the mausoleum of Artemisia, the temple of Diana of Ephesus, the hanging gardens of Babylon, the colossus of Rhodes, the statue of Jupiter Olympus by Phidias, the Pharos or watch-tower of Rhodes.

F. W. PHILLPOTT.—The price of a dynamo, suitable for operating an eight candle-power incandescent lamp, would be about £10.

E. KENNEDY.—Many thanks for your suggestions, and for the information sent. See p. 403. We will take an early opportunity of looking up your cloud atlas. The new electrical experiments will be dealt with in our columns. We fear that we cannot agree with you as to the nature of the aurora.

J. POWELL.—Thanks for the correction. The population of the world is nearly 1,500 millions.

We have been compelled to hold over many replies to correspondents until next week.

SALE AND EXCHANGE COLUMN.

Tariff: First 20 words or less, 6d. Every additional 3 words, 1d. If replies are to be addressed to the office of "Science Siftings," a charge of 3d. will be made for booking and forwarding replies.

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Minerals. Large collection to be cleared from 2s. doz., named, free. Nicholls, Photographer, Redruth, Cornwall. 1

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Pocket aneroid barometer, watch size and shape, in velvet lined case, registering up to 15,000 ft. Sent post free on sending postal order for 10s. 6d. to Pocket Aneroid, SCIENCE SIFTINGS office, 78, Fleet-street, London, E.C.

Situation wanted, lathe and vice, used to small iron and brass, also spinning. Martin, 9, Westdown-road, Stratford.

Tripod stand for sale, never been used. Owner giving up photography. Cost 27s. 6d.; will sell for 10s. Will send on approval against deposit. Address, C. K., care of SCIENCE SIFTINGS, 78, Fleet-street.

Bicycle, long wheel base, cushion tyre, Humber pattern safety, celebrated maker, ball head and pedals, beautiful finish, £6 15s. Soper, 12a, Long-lane, E.C.

For sale, all the numbers of "The Engineer" except five for the years 1880 and 1881. Cheap! Alexander Downie, Long-lane, Aughton, near Ormskirk, Lancashire.

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For sale, 4 pairs of ptarmigan or white grouse, stuffed in the game style. All as white as snow, and very clean. These are a very fine specimen, such birds seldom seen; 8s. 6d. per pair, on approval, carriage paid both ways if they don't suit. Turner, 63, Battye Street, Laisterdyke, Bradford.

Wanted, chemical apparatus, cheap. Particulars to Mr. Lane, Orwell School, Royston.

Electric coil, with regulator, very powerful, with carbon and zinc, complete in box, 15s. Housekeeper, 2, Fenchurch-street, City.

Wanted, apparatus for producing prismatic fountain. Price to Bury George, Algeciras, Spain.

Wanted, school globe, terrestrial. Thos. Dawson, Ulpha, Broughton-in-Furness.

Medical student's set of pathological specimens, cheap, good condition. N., 77, Denmark-hill, S.E.

Student's microscope for sale, Newton, Fleet-street, lenses, object slides, new condition. Will accept 63s., worth much more. C., 15, Aliwal-road, Clapham Junction.

Wanted, student's (or portable) microscope, must be by good maker. A. H., 84, Dresden-road, Upper Holloway.

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Dallmeyer's 2 C Baby lens, cost £15 15s., price £6; Ottewill's oak studio stand, with screw adjustments, for 12 by 10 camera, price 42s. Drury, Stowe, Bedford.

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